TOWARDS ECOLOGICAL SUSTAINABLE SANITATION – OSHIWANA PENDUKA INFORMAL SETTLEMENT

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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature:……. Date:…….

ABSTRACT

This study undertakes a scientific investigation into the social and environmental problems encountered by the Oshiwana Penduka informal settlement as a result of the lack of a proper sanitation system. This informal settlement is located on the periphery of the municipal boundaries of the town of Mariental in Southern Namibia, about 270 kilometres south of the capital, Windhoek. The unique problem faced by the settlement is the absence of sanitation facilities or sewage system as a method of solid waste management. Needless to say, the informal settlement is characterized by overcrowding, poor sanitation, lack of housing, unemployment and poverty. From the literature review, it became clear that inadequate water supply and sanitation posed serious implications to the physical environment and human health. The literature also reveals that these core challenges are propagated by the continual influx of people to urban areas and the re-birth of irregular settlements.

In light of the above, the problem statements to be addressed are the following, namely: what is the impact of the absence of a proper and sustainable sanitation system on the inhabitants of the Oshiwana Penduka informal settlement and what can be done by the Mariental Municipality to address the concerns raised?

The key research methods applied for this study entails individual semi-structured questionnaires and key informant groups. The answers to the interviewed questions are highlighted in chapter four and the interpretation of the research findings are constituted in the latter chapter. The hypothesis was proven false and the new model of thinking generated is suggesting that the prevailing social and environmental problems are caused by the absence of toilet facilities. It is evident to note from the study results that the negative social impact, which is being attributed by inadequate sanitation in the informal settlement, is severe and lethal to human health. In order to prove the hypothesis, data has been collected at household levels from the informal settlers.

Despite the survey results which support the conventional water borne sanitation as the most preferred sanitation system, vacuum system as an ecological sanitation technology is recommended for this informal settlement. This particular sanitation system works on the principle of enhancing water conservation, recycling, reduction of health, and promotes environmental integrity.

OPSOMMING

Hierdie studie onderneem 'n wetenskaplike ondersoek na die sosiale en omgewingsprobleme, wat ondervind word deur die Oshiwana Penduka informele nedersetting en die gebrek aan 'n behoorlike sanitasie stelsel. Hierdie betrokke informele nedersetting is geleë aan die buitewyke van die munisipale grense van die dorp Mariental. Die dorp Mariental is geleë in die suidelike deel van Namibië, ongeveer 270 km suid van die hoofstad Windhoek. Die unieke problem wat hierdie nedersetting ondervind is die afwesigheid van sanitasie fasiliteite of 'n rioolstelsel wat 'n soliede metode van goeie rioolbeheer is. Hierdie nedersetting word gekenmerk deur oorbevolking, swak sanitasie, gebrek aan behuising, werkloosheid en armoede. Vanuit die literatuurstudie, het dit aan die lig gekom dat onvoldoende water toevoer en sanitasie ernstige implikasies vir die fisiese omgewing en die menslike gesondheid inhou. Die literatuur het ook aan die lig gebring dat hierdie basiese probleme vererger word deur die aanhoudende invloei van mense na die stedelike gebiede.

In die lig van bogenoemde, is die probleemstelling wat aangespreek moet word, soos volg: wat is die gevolge van 'n gebrek aan 'n behoorlike en volhoubare sanitasiestelsel vir die inwoners van die informele nedersetting en wat kan die Mariental Munisipaliteit doen om hierdie problem aan te spreek?

Die navorsingsmetode wat aangewend word bevat individuele semi- gestruktureerde vraelyste en sleutel fokusgroepe. Die antwoorde op die onderhoudsvraelyste word vervat in hoofstuk vier en die vertolking van die navorsingsbevinding word in die daaropvolgende hoofstuk aangebied. Die hipoteses was verkeerd bewys en die alternatief wat gegenereer is, stel voor dat die bestaande sosiale en omgewingsprobleme veroorsaak word deur die afwesigheid van toilet fasiliteite.

Ten spyte van die navorsingsresultate, wat 'n watersanitasiestelsel as die meeste verkose stelsel ondersteun, word 'n suigstelsel as ekologiese volhoubare tegnologie vir hierdie informele nedersetting aanbeveel. Hierdie betrokke sanitasiestelsel toon verskeie voordele, onder andere bewaring van water, vermindering van gesondheidsprobleme en die bevordering van omgewingsvolhoubaarheid.

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INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

This study intends to undertake a scientific investigation into the social and environmental problems encountered by the Oshiwana Penduka informal settlement, as a result of the lack of a proper sanitation system. This informal settlement is located on the periphery of the municipal boundaries of the town of Mariental in Southern Namibia, about 270 km south of the capital, Windhoek. The unique problem faced by the informal settlement is the absence of sanitation facilities or a sewerage system as a method of solid waste management. This phenomenon has led to multiple problems, such as the indiscriminate and unacceptable depositing of human urine and excreta (faecal matter) in open public places. An understanding of multiple problems will enhance and broaden specific areas of knowledge (Brynard & Hanekom, 1997: 11). According to De Vos et al. (2005: 268), qualitative research is aimed at conceptualizing a problem.

According to the literature, untreated excreta and waste water contains organic matter, trace elements as well as pathogenic bacteria and viruses (Werner, 2003:23). It is elaborated by stating that if this problem is not properly attended to by responsible authorities, for example municipalities, it is tantamount to creating a hazard regarding undesirable disease conditions in the environment. In light of the above, the interest of the researcher was triggered to conduct focussed qualitative research on the lack of sanitation in this particular informal settlement. Secondly, by virtue of the researcher's career in development planning, notably at regional level it was deemed necessary to gain knowledge about multidisciplinary dilemmas experienced by the informal settlement. Thirdly, the researcher was eager to draw inferences from research results, which will be obtained through the process of data collection and analysis. Subsequently, recommendations will be formulated in a project document, which will be forwarded to potential donor agencies for possible funding.

1.2 BACKGROUND TO THE STUDY

Oshiwana Penduka is an informal settlement, which is located within the town boundaries of Mariental, the regional capital of the Hardap region in the Republic of Namibia. The name of the informal settlement is derived from the Oshiwambo language and the settlers are predominantly from this ethnic group.

In the Namibian context, Mariental is considered to be an urban centre, which was declared a municipality on 21 January 1946 (Hardap Regional Council, 2000:4). The town is geographically located south of Windhoek, the capital city of Namibia, and strategically encompasses the B1 main road, which is connected with the South African N7 main road. Shortly after the establishment of the regional governance system in 1992, the town was accorded the status of regional capital. According to the Central Bureau of Statistics (2001:7), the total population of the Mariental Urban Constituency was 13 109 people.

Prior to independence in 1990, it was rare to observe the free movement of people from orderly demarcated plots to informal settlements. At that time the total area and population size of informal settlements were minimal and easily manageable. Presently the situation portrays an ugly face and it is reprehensible to observe the rapid influx of people into this particular informal settlement. This urbanisation trend poses developmental challenges for local authorities, mainly owing to financial constraints. The provision of urban sanitation services requires high investment, which should run parallel with operational costs.

The Oshiwana Penduka informal settlement is characterized by overcrowding, poor sanitation, lack of adequate housing, unemployment and poverty. Most of the occupants of this settlement belong to low-income groups. The settlement provides shelter for approximately 2000 – 3000 people. From the researcher's own observation it is estimated that five to six people live in one small makeshift house. These houses are constructed from traditional materials, such as corrugated sheeting. During the hot season, the occupants are exposed to high temperatures, which are detrimental to their

health. During the rainy season, the houses are susceptible to severe leaking and flooding. These environmental hazards are largely caused by poor topography and the water catchment area, which is in close proximity to the settlement.

The prevailing poor sanitation represents a potential danger to children and women. The pride and dignity of the women are at stake, because they are compelled to defecate and urinate in the open due to lack of sanitation structures. The absence of a safe and adequate sewerage system forces them to walk long distances to the nearest riverbed and bushes. As part of the latter problem, babies are vulnerable to this situation and run the risk of eating loose faecal matter.

To ease the burden of unemployment, the settlers engaged in unsustainable economic activities. They derive their income from unhygienic open informal markets and unlicensed liquor establishments. These liquor outlets have become a public nuisance, because of the noisy music, violence and prostitution. It is also a centre of attraction for school going children. The sale of liquor is governed by the Liquor Act, 1998, Act no. 6, which compels all liquor outlets to provide toilet facilities for customers. The non-compliance of this legal obligation by liquor operators, largely exacerbates littering and defecation in public places.

Social amenities such as water and electricity have been made available to the settlers. In terms of water provision, the Mariental Municipality has opted for communal water in the form of standpipes. The standpipes were constructed at random around the settlement and the water is acquired by means of water tokens. As far as electricity is concerned, disorderly overhead electricity wires run through the informal settlement. Even though it might be perceived as disorganized and dangerous, settlers at least have individual electrical connections to their disposal.

Against this background, the researcher developed an interest in the social and environmental problems which have resulted from the absence of a safe and adequate sanitation system in the Oshiwana Penduka informal settlement. The study will

investigate coping mechanisms which have been introduced by the settlers and how these mechanisms satisfy the social, economical and psychological patterns of the daily lives of the settlers. The researcher will investigate what development plans the Mariental Municipality has made for the informal settlement regarding sustainable ecological sanitation.

1.3 RESEARCH PROBLEM

The absence of sanitation facilities creates social and environmental problems such as the spread of water related disease by mosquitoes, which breed on open scattered human excreta during the rainy season. Moreover, the untreated excreta contain pathogenic bacteria and viruses, contributing to unknown diseases and causes environmental harm to the informal settlement. If some segments of the setttlement opted for a pit – latrine toilet system, underground water would be detrimentally affected and might cause irreversible environmental damage. The frequent movement to and from the river for defecation and urinating by the settlers creates inconvenience when compared to those who enjoy the comfort of a conventional water borne sanitation system.

In light of the above, the problems to be addressed are the following, namely: what is the impact of the absence of a proper and sustainable sanitation system on the lives of the Oshiwana Penduka informal settlement and as stakeholders what can be done by the Mariental Local Authority and the Regional Department of Water Affairs to address the concerns raised? To uncover whether policy planning on sanitation is linked to aspects of sustainability.

1.4 HYPOTHESIS

The independent variable for the study is sustainable sanitation and dependable variables are social and environmental problems caused by the lack of appropriate sanitation system. Therefore, the study will be based on the core assumptions that

social and environmental problems as well as lack of sustainable sanitation policies are not directly connected to the absence of a sanitation system.

1.5 OBJECTIVES OF THE STUDY

The objectives of the study are:

- To determine social and environmental problems which have been caused by the non-availability of a sanitation system for the Oshiwana Penduka informal settlement.
- To find out coping mechanisms adopted by settlers in the absence of a sewage system.
- To find out development intervention measures of the Mariental Municipality as well as other key stakeholders in addressing the problems identified.
- To draw conclusions and make recommendations to improve the sanitation at the Oshiwana Penduka settlement.

1.6 RESEARCH METHODOLOGY

The results obtained from the study could be applied to solve an imminent problem that is perceived as intractable. This study will be carried out in the public domain and key stakeholders will be approached in pursuit of information and experience sharing. The proposed development actions will contribute towards rectifying an existing unacceptable situation. The results will be made available for future planning. A qualitative research methodology will be the most appropriate mode of inquiry and relevant data will be gathered. As reported by Brynard and Hanekom (1997: 30), qualitative methodology enables researchers to come face to face with respondents to experience their daily struggles. The key research methods that will be applied for this particular applied research study entails individual semi-structured questionnaires amongst stakeholders, inter alia, the Mariental Municipality and Regional Department of Water Affairs.

To ensure high response rate, former school youths will be integrated as assistant interviewers in the collection of data through individual semi-structured questionnaires. Questions will be formulated around core themes and will be supplemented with open ended questions so that respondents may relate their situation in their own terms. As a matter of procedure and for ethical consideration as well as the public domain nature of the research, the established representative block committees of the informal settlement will be informed through formal meetings or letters. To warrant a successful outcome, the assistance of the community development officer of the Mariental Municipality will be required to solidify confidence and trust between the assistant interviewers and respondents.

The estimated population of the informal settlement is between 2000 - 3000 people. The makeshift structured houses are in the range of 200 - 300. The data collection process will be done on physical households rather than on individuals of the informal settlement. The study will preferably select the head of the household as a respondent for the data collection process. The sample size will be determined by the total number of households. From the estimated total houses of 300, it is statistically correct and justifiable to interview 130 houses, which will finally produce 130 questionnaires for statistical analysis. With the collection of data, a computer software programme will be used for processing, analyzing and interpretation of data.

With respect to key informant group interviews, the study has developed semi-structured questionnaires, which are institutional specific on the development programmes and policies of the respective groups. The key groups identified for the collection of data are amongst others, the Mariental Municipality and the Ministry of Agriculture, Water and Forestry (Department of Water Affairs). The focus will be directed towards regional heads of these organizations for the completion of the questionnaires.

1.7 RESEARCH DESIGN

According to De Vos et al. (2005:270), "grounded theory is discovered, developed and provisionally verified through systematic data collection and the analysis of data pertaining to that phenomenon. Therefore, data collection, analysis and theory stand in a reciprocal relationship to one another. The researcher does not begin with a theory and then prove it; rather he begins with an area of study and what is relevant to that area is gradually allowed to emerge.''

1.8 LIMITATIONS OF THE STUDY

An apparent absence of institutional specific documentation and information by the Mariental Municipality was a limitation. These limitations have negatively influenced the citation of references in the text. Owing to the latter, information related to the study was based on estimations and probable assumptions. The non-response by the official of the Ministry of Health and Social Services to complete the stakeholder questionnaire has denied the study vital information. In a way to address the limitations, all relevant stakeholders are urged to show commitment and cooperation to ultimately develop extensive knowledge on phenomena, which is being investigated.

1.9 DEFINITION OF KEY TERMS

The following key terms are relevant for the study:

Informal settlement: Holm and Stalas (1996:7), defines the informal settlement as homeless people settling illegally where permanent residences are not planned. The settlers do not participate in the local government and remain unconnected to the municipal service network. The Municipal authorities tend to ignore the social needs of the informal settlements, because it far outstrips the human and financial capacity of the local governments. Kinley (1994:1) indicates that the informal settlement of Kumasi in Ghana is perceived as a ramshackle settlement constructed of sticks, mud bricks, plastic bags and cardboards. The children play in the narrow pathways littered with

garbage and streaming with raw sewage. A lone tap is spurting water into the jugs and wash basins of scores of women and girls waiting in a queue. A baby lies beneath a sheet tin, wasting away from the effects of intestinal parasites. According to the author this unfortunate scene could be almost anywhere in Africa, Asia or Latin America. Napier (1997:8) defines informal settlements in a variety of ways, but there is general agreement on their core characteristics.

Such settlements are created through a process of unassisted self-help and tend to have two or more of the following characteristics when they are initially created:

- Houses are self-built by the families occupying them and using temporary building materials;
- The settlements are illegal in some way (whether that is the land tenure, the house construction or both); and
- Settlements are unserviced and mostly occupied by people living in situations of poverty.

These key descriptions of settlements are not exhaustive and there are many more questions about the context of settlements such as physical location and conditions. Other factors include the institutional context (government and non-government supporters or opposers of informal settlement) and the legislative and regulatory conditions. It is further stated that the information about the current state of informal settlement, informal housing and squatting in sub-Saharan Africa is fairly patchy, at least at a statistical level. Napier (1997) states that there are at least three recognized measures of informal housing that can be applied as measures indicative of the prevalence of the informal settlement, namely; tenure, housing construction, and access to services. According to Sclar (2003:1382), slum dwellers often have no official addresses and are commonly denied the basic rights and entitlements, including the right to vote, public education and health care.

*For the purpose of this study: the working definition of **informal settlement** is a substandard settlement, where tenure rights and electricity networks for poor people are denied and constantly subjected to social and environmental hazards.*

Sustainable development: Sustainable development is defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their needs (WCED, 1997:32). Todes et al. (2002:9), regards sustainable development as an end point, whereas the concept of sustainability is the pathway, the direction in which global citizens must move. According to Sachs (2005:32), sustainable access to sanitation must be viewed from social, economic and environmental perspectives. He states that access to sanitation cannot simply be measured on the mere installation of a toilet facility. The toilet must be fully operational and used for the safe disposal of excreta with improved hygienic practices. If not, the contribution of the toilet to human health will be negligible. In terms of service, sustainable access to sanitation refers to the secure, reliable and available service to users on a long-term basis.

The goals of sustainable development must attain economic development, social equity and environmental protection (Sachs, 2005:32)**.** It is stated by the UN Volunteers News (2004:2), that sustainable development requires people's engagement**.** People are development actors and not only recipients. Notions of inclusion, participation, ownership, solidarity and social cohesion leading to real capacity development and social capital come to mind. It is also put forward that progress towards sustainable development comes through improved access to energy services for the poor. Secondly, it's about equitable management of land and water, sustainable use of biodiversity and measures to address climate change (United Nations Development Programme, 2003:18).

*For the purpose of this study: the working definition for **sustainable development** is an equitable, durable, affordable and environmentally friendly policy, which is able to maintain present public health systems over a long-term period.*

Ecological sanitation: Sachs (2005:30) defines basic sanitation as the lowest-cost option for securing sustainable access to safe, hygienic and convenient facilities and services for excreta and sullage disposal that provide privacy and dignity, while at the same time ensuring a clean and healthy living environment both at home and in the neighbourhood of users. According to Rockström et al. (2005:10), ecological sanitation is described as the containment of human excreta, its sanitization and recycling back to the soil. Extended metaphor on ecological sanitation is presented and articulated as a self-composting sanitation system (Lagardien & Cousins, 2004: viii).

According to Peasay (2000:17), the ecological sanitation toilet was developed by the Society for Urban Development in East Africa. It is described as a urine diverting or non-mixing toilet that enables separate handling of faeces and urine. The urine is collected in a special container. The faeces are also collected in a special container and mixed with ashes, soil, leaves, grass or sawdust. The urine and composted faeces can be used as a fertilizer. It is recommended that neither urine nor composted faeces should be spread on top of the soil, but should be used under the topsoil. The toilet is constructed from locally available and appropriate materials.

In 2004 in Windhoek, Namibia, the concept of ecological sanitation was clarified at a promotional multi-stakeholders workshop, which was organized by the Gesellschaft für Technische Zusammenarbeit (GTZ). In her written version of the presentation, Werner (2004), states that ecological sanitation is not a specific technology, but a new philosophy, which is based on a holistic view of material flows. An ecological sanitation system deals with what is presently regarded as waste and waste water for disposal. Werner states that the ecological sanitation system is based on the systematic implementation of the reuse and recycling of nutrients and water. Werner is adding that this particular system is capable to recover nutrients from human faeces and urine for the benefit of the agricultural sector. It could preserve soil fertility, food security for poverty-stricken families; minimize pollution and the recovering of bio-energy. She

highlighted that ecological sanitation promotes the economical use of water resources and presents plethora of opportunities for recycling in a safe way.

According to Ashpole (2004:3), the ultimate objective of ecological sanitation is to protect human health and the environment while reducing the use of water in sanitation systems. Ecological sanitation represents a conceptual shift in the relationship between people and the environment and is based on the necessary link between people and soil. The approach to ecological sanitation can be broadened to cover all organic material generated in households. If these organic materials are sorted within the home, rather than mixed or dumped, they become valuable recyclable materials once composted. Grey water can be treated by using biological systems such as evapo-transpiration beds and constructed wetlands. Sanitation should no longer be regarded as a linear process. In all likelihood, it must embrace a holistic approach incorporating wider issues of the amelioration of poor quality soils, poverty alleviation and food shortages.

The picture above is a typical example of urine diversion toilet that is currently in use in Takarania, an informal settlement in Mariental. The front chamber is for the collection of urine for male as well female as per the design of the toilet. The back chamber is for the collection of faeces and all solid stuff.

According to Roediger (2005:19), vacuum technology is particularly applicable to systems designed in accordance with the ecological sanitation concept. Vacuum toilets

and interface valve units are major components of the system, where foul and grey water is to be collected and treated separately. The foul water from vacuum toilets and urinals is collected under vacuum and transported for biological treatment. During the treatment process, biogas is produced, which has a high methane content, together with other biodegradable residues. The biogas can be redefined and used as an energy source, whilst the biodegradable residues can be mixed with other green waste to produce compost. This can be used as a soil conditioner in either horticulture or agriculture, thus closing the recycling loop. As far as grey water is concerned, it may be treated in natural treatment ponds and re-used afterwards for irrigation (Roediger, 2005:19). Additionally, black water can also be collected separately from urine and faeces. After urine is gathered undiluted and stored for some months, it can be used as a fertilizer in agriculture. Certain ingredients such as phosphates and nitrates can be used further in the chemical industry.

*For the purpose of this study: the working definition for **ecological sanitation** is the recycling of urine and human faeces and organic fertilizers, the economical use of precious water resource and the elimination of excessive contamination of the living environment with faecal matter.*

Water borne sanitation system: As reported by Abelho (2006:66), the water borne sanitation system is more conventionally a gravity system in urban areas with infrastructures or on smallholdings, farms, in rural communities, townships or other settlements – septic tanks, long drops, latrines and French drains. According to Austin and Van Vuuren (2001:29), water borne sanitation systems have been widely used in cities to control the transmission of excreta-related diseases. However, these systems have created severe damage to ecosystems and natural water resources where waste water is inadequately treated. The aforementioned worrisome situation prompts the research study to indicate vacuum and urine diversion system as alternative sustainable sanitation system. Abelho (2006:66) expressed that water borne sanitation systems used a lot of valuable water to move the waste along the pipes in the public sewer

network. Furthermore, the contamination of groundwater from untreated sewage is growing with an increase in people who have no alternative sanitation.

According to (http:// en.wikipedia.org/wiki/sewer, 16 June 2006), sewers are integral components of water borne sanitation systems. The sewers transport waste water from buildings to treatment facilities and sewers are pipelines that connect buildings to horizontal mains. The sewer mains are often connected to larger mains and to the waste water treatment site. The sewers are generally gravity powered, though pumps may be used if necessary. According to Steward (1985:59), a water borne sanitation system is one of the great systems of the modern times. He explains that in the house, there is a pan with a water seal and vent, which is connected to a drain, a sewer and a treatment farm. Disposal of the waste takes place at the treatment farm, where solids are removed and the effluent is treated. The effluent can be purified to a potable standard and the re-use of effluent are essential.

For the purpose of this study: the working definition of a ***water borne sanitation system*** *is an unsustainable public health system, which tends to be inefficient to control the transmission of excreta related diseases in the face of rapid urbanization.*

1.10 STRUCTURE OF THE STUDY

The study is divided into five chapters and their content is listed as follows, namely:

In chapter 1, details of the phenotypical appearance and problems prevailing in the study area will be described. Key research dimensions, which are integral to the study such as demarcated research problems and objectives, hypothesis, research design, research tools and methodology, will be formulated. A discourse on key definitions, concepts, components, characteristics and elements, which are applicable to ecological sustainable sanitation, will be described. In chapter 2, the conceptual framework for ecological sustainable sanitation will be dissected. This chapter will review relevant literature, which will put into perspective aspects of ecological sanitation. The rationale

of this approach is necessary to provide better insights about ecological sustainable sanitation as a public health system

Chapter 3 is meant to explore the policy, legal and constitutional frameworks governing the planning, management and implementation of sanitation programmes within Namibia. In pursuing this approach, it is believe to uncover whether policy planning on sanitation is linked to aspects of sustainability. Through this undertaking the researcher is eager to develop an understanding about the rate of implementation of sanitation programmes and successes achieved at national, regional, local and community levels. As planning frameworks of national development, focus will be directed towards Vision 2030 and the National Development Plans to assess the commitment demonstrated towards sanitation for the Namibian citizens. As an integral part of the study, the researcher will take a closer look at the development initiatives made by the Mariental Municipality for the informal settlements. This approach will be twofold, namely: to evaluate the development efforts made by the Mariental Municipality, particularly sustainable sanitation for the settlers and to assess whether the latter institution is in support of sustainability as an important dimension of contemporary development planning. The results of the pilot study which was conducted in the Takarania informal settlement will be discussed.

Chapter 4 will explain findings regarding the Oshiwana Penduka informal settlement. Relevant and necessary inferences will be drawn from the findings. In chapter 5, a summary of the theoretical constructs about the chosen chapters will be put into perspective. To warrant future policy formulation and implementation on the existing problem by key stakeholders, appropriate recommendations will be made for consideration. As a guiding component of the study, the hypothesis will be articulated in this part to prove the preliminary assumptions made.

1.11 CONCLUSION

The primary aim of this chapter is meant to outline the key research components and aspects that are directly linked to the study. It is also a chapter which is known to set the stage for the entire research process. The clear articulation of the research objectives, problems and hypothesis is essential in creating a framework for the study. In adopting this approach, the researcher will be guided in conducting the study accurately. As of critical importance, relevant questions will be developed for household survey as well as for the key informants such as the Mariental Municipality and the Department of Water Affairs. The data collected will be analyzed, presented and key inferences will be drawn to test the hypothesis which was formulated.

CHAPTER TWO

CONCEPTUAL FRAMEWORK FOR ECOLOGICAL SUSTAINABLE SANITATION

2.1 INTRODUCTION

This chapter covers the conceptual framework for ecological sustainable sanitation. The following key concepts as indicated in section 1.9 have been broadly contextualized, namely:

- Informal Settlement;
- Sustainable Development;
- Ecological Sanitation; and
- Water Borne Sanitation System;

A holistic review of the literature on public health and the environment as innate concepts of sanitation will be explored. Through this undertaking, it is believed that insight on the distinct role and purpose of public health in settlements and cities will be acquired. Without imposing limits on the aforementioned, an understanding of the causal relationship between inadequate sanitation systems and public health will be reviewed. Notwithstanding the above, the impact of inadequate or unavailable sanitation on the lives of poor people in urban centres will be elaborated upon. In addition, owing to a lack of adequate sanitation systems, potential problems of the occurrence and transmission of disease conditions and environmental threats are inescapable. Taking cognizance of the above, a literature review will be carried out to gain the required knowledge of this topic. A multitude of sanitation challenges and alternative sustainable sanitation technologies as public health systems will be covered. A review of the description of current ecological sanitation technologies, the advantages and disadvantages to human health and the ecosystem will be addressed.

2.2 DEVELOPING A PUBLIC HEALTH ENVIRONMENT

The concept of public health at the Third World Health Assembly held at Geneva in 1950 defined public health and environment as related concepts (Steward, 1985:27). According to Steward, the relation entails, "the science and art of preventing disease, prolonging life and promoting mental and physical health and efficiency through organized community efforts for the sanitation of the environment, the control of communicable infections, the education of the individual in personal hygiene, the organization of medical and nursing services for the early diagnosis and preventive treatment of disease and the development of social machinery to ensure to every individual a standard of living adequate for the maintenance of health, so organising these benefits as to enable every citizen to realise his birthright of health and longevity".

Furthermore, health is defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or deformity" (Burstrom et al. 2005:210). As interplay of public health, environment is defined as the totality of circumstances confronting an organism from its beginning to its end. According to Steward (1985:28), modern health programmes begin with environmental health, geophysical sanitation, the abolition of poverty (which governs nutrition and housing) and with education (adaptation to a changing world and adjustment in attitude, cultural and ethnic factors and social behaviour). Complementary to the above, environmental health refers to the balance that must exist between mankind and the environment in order to ensure his/her well-being.

The inter-relationship between the environment and health is becoming increasingly more apparent. On a cautionary note, it is being advocated that the relationship to the environment is in a state of flux and should this adaptability fail, the ecological balance will no longer be fulfilled. In support of the latter, the literature also holds the view that the present day environmental damage is causing concern. Against this background, it is being urged wherever possible to prevent environmental health hazards and where health hazards do exist, their ill effects must be eliminated (Steward, 1985: 29). In spite

of the call to refrain from causing environmental health hazards the literature also highlights other health hazards that are producing eco-catastrophies and placing stress on the environment. These include, amongst others chemical elements, hazards and noise of the countryside and overcrowding.

According to Steward (1985:30), the environment must be tailored to fit mankind and must provide opportunities for full expression by both individuals and groups. Through such tangible efforts, it is considered a necessity to reinforce full character development which will result in balanced and resilient human beings. In his quest to define health , Steward (1985) seeks to support a transdisciplinary approach to health and reiterates that health cannot be achieved merely by a single medical discipline. This particular sentiment of the author supports the coordinated roles of other multiple disciplines in urban public health (Vlahov & Galea, 2003:1091). The latter authors suggest that urban health is currently the domain of multiple disciplines. Firstly, urban planners can bring to the field perspectives about city designs and how this might affect the behaviour and even well-being in cities. Secondly, urban sociologists study the interactions in densely populated cities. Thirdly, epidemiologists document the burden of disease in urban areas and the factors associated with those diseases. According to Vlahov and Galea (2003:1091), it is discouraging to discern that these disciplines seldom interact using the same academic language and that barriers exist to true cross-disciplinary work.

In a historical context, sanitary reforms were initiated in European and North American cities in the 19th century (United Nations Human Settlement Programme, 2003:159). During that time, most of the economically successful industrializing cities were unhealthy to live in and epidemics were common. Crowded and unsanitary living conditions were often blamed, while the problem of inadequate sanitation was compounded by local environmental hazards. During the second half of the 19th century, water and sanitation emerged as public issues, with piped water and water-flushed toilets and sewers the principal urban solutions. During the 20th century, efforts were made to improve public water and sanitation provision at institutional level in cities

around the world. Other historical perspectives cite sanitation systems as measures of public health, which were built in 19th and 20th centuries (Knowlton, 2001:1945).

During this particular period, tangible efforts were made to eliminate the sanitation problem and frequent epidemics facing the American urban population. By the 20th century, the problems of adequate sanitation and infectious diseases had been brought under control and were no longer the primary drivers of urban planning. Furthermore, the literature reveals that these sanitary systems were built permanently and appear to be inflexible to resist adaptation in this era. While it appears to be a solution to disposing of human excreta, it has created severe damage to global ecosystems and natural water resources. It is suggested that in the near future, this problem will be huge owing to rapid urban population growth, which will be characterized by features such as promiscuous defecation and urination by urban slum dwellers.

Noting of the historical discourse and evolution on sanitary systems, the basic purpose of any sanitation system is to contain and dispose human excreta (Austin & Van Vuuren, 2001:31). According to the latter authors, water borne sanitation systems have been widely built to control transmission of excreta-related diseases in most cities of industrialised countries. In the absence of adequate sanitation facilities human excreta are spread throughout the environment, while the soil and bodies of water are negatively affected. According to Peasay (2000:5), sanitation of any kind is promoted for a variety of reasons, but the two most common objectives are human health and environmental protection.

According to Mara (1996:11), there is a confluence between improved urban sanitation and improved public health system. In pursuance of improving public health through improved sanitation, emphasis is placed on the understanding of diseases which is prevalent when sanitation is poor. According to the author, most excreta-related diseases are caused by viruses, bacteria, protozoa and helminths (worms). In terms of excreted infections, the pathogen that causes the infection has to pass from the excreta of one person to the mouth of another person. In addition, successful transmission

depends on how many pathogens are excreted by the first person and how these numbers change during transmission in the environment (Mara, 1996:12). The number of pathogens excreted is termed the excreted load. The number of changes of the pathogens during its environmental transmission is being governed by three key properties of the pathogen and is quoted as follows, “latency or how long it takes for the pathogen, once excreted, to become infective; persistence, or how long the pathogen can survive in the environment; and multiplication, the ability of the pathogen to increase its numbers whilst in the environment. A fourth key property of the pathogen is its infectivity which is the probability of one organism initiating infection” (Mara, 1996:12).

2.2.1 URBAN AND RURAL CHALLENGES OF SANITATION

Inadequate water and sanitation provision is regarded as a major cause of high mortality and morbidity rates in urban areas of many developing countries (Emmett & Rakgoadi, 1993:11). According to the authors, most widespread diseases in developing countries are those transmitted by human faeces and water as a major medium of transmission. There is a relationship between morbidity rates and the quality and quantity of water to which people have access. The authors state that empirical studies have shown that the shorter the distance to safe sources of water, the lower the incidence of diarrhoea. Households with water inside the dwelling tend to have the lowest rates of diarrhoea, followed by those with water outside the dwelling, while those far from water sources have the highest rates of infection. To clarify the understanding on diarrhoea, it was defined as the presence of at least three loose stools in a 24-hour period (Cunnan & Maharaj, 2000:677). The risk factors that increase the incidence of diarrhoea are set out below, namely:

- An absence of an indoor flush toilet in the household increased the risk of diarrhoea threefold;
- The incidence of diarrhoea is increased 2,5 fold if the household does not have its own refuse receptacle; and
- The lack of indoor piped water.

According to Emmett and Rakgoadi (1993:12), poor water and sanitation are also widely regarded as important contributory causes of high infant and child mortality rates in underdeveloped rural areas. Clarke (1994:4), states that dirty water is a major cause of human disease, misery and death. The literature states that as many as 4 million children died as a result of diarrhoea caused by water borne infection. It is further claimed that none of these deaths would have occurred if the standards of sanitation that developed countries have long regarded as essential also prevailed in developing countries.

Emmett and Rakgoadi (1993:16) pointed out that inadequate water supply and sanitation posed serious implication for the environment. They illustrated that inadequate sanitation has been a major cause of degradation of surface water and groundwater. Contamination of groundwater is often more serious, because it can take decades to cleanse polluted aquifers. There is also the misguided perception that it is safe to drink untreated groundwater. Other predisposing factors to environmental damage are directly caused by a lack of access to piped water. According to Emmett and Rakgoadi (1993:16), this shortcoming necessitates poor people to extract groundwater by means of wells and boreholes. This injudicious activity of accessing water has led to over pumping and the depletion of groundwater resources. A mechanical defect in water technologies, such as uncontrolled standpipes often leads to wastage of water. As far as uncontrolled digging of wells is concerned, results obtained from a community environmental health assessment in Peru's Desert Hills and rain forests are disappointing (Baffigo, 2001:1580). The results show the mounting impact of rapid population growth on the physical environment. The purpose of the results is geared towards showing the impact and levels of contamination as propelled by rapid population growth. The gloomy picture painted by the results indicates:

- A total of 12 from 13 shallow dug wells tested positive for coliforms;

- Inadequate management of human waste and the existence of many poorly developed dug wells allow contamination of the groundwater source and community drinking water wells; and
- Only one of the 11 community wells tested not positive for coliforms.

Heavily polluted water can lead to water scarcity, because dirty water is of little use unless it can be cleansed (Clarke, 1994:3-4). It is succinctly stated that the world's available supplies of water are becoming increasingly polluted. Many rivers are polluted from the source to the estuary – the natural cleansing action just cannot cope. Every year some 450 km^3 of waste water are discharged into rivers and streams. A further 600 km^3 of clean water is needed to dilute and transport this dirty water before it can be used again. According to United Nations Development Programme (1998:68), a supply of clean water is one of the most basic human needs.

Hogrewe et al. (1993:5), mentioned that most urban areas (both informal and formal) in Africa and Asia have no effective means of off-site disposal of excreta, for example, water borne sewage systems or collection and treatment systems for latrine contents. Water in the rivers and streams are the destinations of most untreated human excrement and household waste. Waste is accumulated in streets, open spaces between houses, in stagnant pools of water and on wasteland. The formal urban areas in most of these cities have some collection and distribution systems, although most existing systems are in disrepair. Cholera outbreaks in Latin America have been partially attributed to the contamination of water distribution systems due to leaky sewage pipes.

The congestion of people in peri-urban areas creates favourable conditions for the rapid spread of a variety of infectious diseases, often in the form of disastrous epidemics (Hogrewe et al. 1993:6). Health problems resulting from a lack of sanitation facilities are greater among the urban poor living in overcrowded peri-urban settlements than in the rural areas. A variety of intestinal parasites are usually present among the poor urban populations, with roundworms and whipworms often observed at higher levels of

incidence than in corresponding rural populations. The accumulation of waste water, as a result of the limited soil area to absorb it in densely settled urban areas, has led to increased transmission of filariasis in many cities. Like cholera and intestinal parasites, tuberculosis is a prevalent disease that exists in the human environment (Cunnan and Maharaj, 2000:676). According to the latter theoretical framework, the disease is commonly transmitted from an infected person to an uninfected person by droplets of nuclei, which is created through coughing or sneezing. While the disease is capable of causing wide spread infection, active transmission of the disease is primarily driven by unfavourable social conditions. From the perspectives of Cunnan and Maharaj (2000:676), impoverished socio-economic conditions such as poor housing, overcrowding, malnutrition, lack of sanitation, and lack of hygiene, emotional and physical stress facilitate the conversion of the dormant infection into a disease.

The United Nations Human Settlement Programme (2003:57), pronounced that the predisposing factors attributing to severe health impacts in urban areas is the absence of competent, effective local governments and or water and sanitation utilities. In the absence of such institutions and the resulting lack of investment in infrastructure, service and waste management, urban concentrations becomes a serious health disadvantage. The World Health Organisation has also recognized that when the infrastructure and services are lacking, urban areas are amongst the world's most life-threatening human environments. The lack of adequate peri-urban sanitation provisions has grave environmental consequences for human health (Hogrewe et al. 1993:23).

These peri-urban areas are regarded as the largest source of faecal contamination in a given city. According to Hogrewe et al. (1993:8), the lack of excreta management systems in Third World cities has a very negative effect on the environment and contaminates surface and groundwater with organics, nutrients and solids. As a result of their current, and growing size and density and their lack of adequate infrastructure, it is suggested that peri-urban areas are the largest source of faecal contamination in cities. Men, women and children often defecate on open ground. In communities, where widespread use of pit latrine has been achieved, human waste can still harm the

environment. The lack of adequate sanitation systems for families living in peri-urban areas is a major contributor to the water pollution in cities. The urban population of India is already putting stress on the infrastructure of their mega cities (Chakrabarti, 2001:260). Ground water is depleting rapidly, the population is reaching crisis levels, sewerage and sanitation are in a shambles and all of this is affecting public health and hygiene.

In the South African context, alarming proportions of sewage waste in towns do not reach treatment plants, because of leaky sewage pipes (Austin & Van Vuuren, 2001:29). This is regarded as one of the most pressing water quality problems in the country. Even, when sewage waste reaches the treatment plant, poor operation or malfunctioning systems mean that partially treated sewage effluent is discharged into rivers. Cunnan and Maharaj (2000:667), in a study of the Canaan informal settlement in Durban, found that the newly urbanized poor find themselves living in squalid conditions, which are detrimental to their health. They argue that the majority of urbanized blacks are forced to live in informal settlements that lack the basic amenities such as water and sanitation. The absence of adequate public services in the Canaan informal settlement has resulted in the spread of tuberculoses (Cunnan & Maharaj, 2000:676). Part of the poor health conditions has been attributed by socio-economic conditions such as poor housing, overcrowding, malnutrition, lack of sanitation, and the lack of hygiene, emotional and physical stress.

According to Wall (1997:275), the infrastructure challenges facing developing countries, particularly in the water and sanitation sector are formidable. The rapid population growth and urbanization are stretching the physical capacities of the infrastructure and the limits of the natural ecosystems. The budgets of governments cannot accommodate the competing demands for investment resources. The literature states that many public institutions suffer from weak management and a lack of an incentive structure to motivate reform. As a consequence, a thousand million people still lack access to an adequate supply of water and 1, 700 million do not have adequate sanitation facilities.

3. ECOLOGICAL SANITATION TECHNOLOGIES

Sanitation approaches, which are based on flush toilets, sewers and central treatment plants cannot solve the rising sanitation problems (Austin & Van Vuuren, 2001:30). Ecological sanitation is an ideal sanitation framework, because Southern Africa is prone to recurrent droughts, water shortages and on-going severe sanitation backlogs (McDiarmid, 2004:2). Sachs (2005:6) reinforces the view that disease and the lack of access to safe water and sanitation can be carried forward with practical and efficient technologies. These technologies must be efficient so that families trapped in poverty can escape inadequate sanitation once and for all. The alternative is to link a bold idea with a practical and efficient technology and push the idea and technology forward through mass citizen action.

Werner (2003:26) states that an ecological sanitation technological system constitutes nine core advantages, namely:

- Promotes recycling by way of safe, hygienic recovery and the use of nutrients, trace elements, water and energy;
- Improves human health by minimizing pathogens from human excreta into the water cycle;
- Substitution of chemical fertilizers and the minimization of water pollution;
- Preference for modular, decentralized partial flow systems for more appropriate, cost effective solutions;
- Increases user comfort and offers security to women and girls
- Preservation of soil fertility;
- Improvement of agricultural productivity and contribution to food security;
- Promotion of a holistic, interdisciplinary approach (hygiene, water supply and sanitation, resource conservation, environmental protection, town planning and agriculture); and
- Instead of disposal, there is a material flow cycle.

The operational framework of ecological sanitation is associated with positive and negative implications (Werner, 2003:24). Positive implications include the notion of sustainability, whereby nutrients obtained from humans become essential commodities for agricultural purposes. Furthermore, users are unaware and misinformed by the biological and environmental benefits accrued by ecological sanitation. Against this background, it is critical to understand the causal link between untreated excreta and that of waste water. Waste water contains elements such as organic matter, plant nutrients, trace elements, micro-nutrients, viral pathogens, helminths and medical residues. These elements are poorly treated by the responsible institutions, and this is tantamount to encouraging disease outbreaks and environmental hazards. However, if managed optimally it can add value to local resources.

In view of the above, there are appropriate and affordable technologies which can contain waste water, urine and faeces for multiple uses. Taking note of the abundance of choices, the study will limit itself to two technological systems, namely the vacuum sanitation system and the urine diversion system. The choices made in favour of the aforementioned systems, were primarily for the sustainable benefits associated with these systems.

4. THE VACUUM SANITATION SYSTEM

According to Abelho (2006:66), the vacuum sewer system is a reticulation system that incorporates a collection point and a subsequent pipe network. It can therefore be compared to a conventional gravity system. In terms of the financial installation costs, it is cost less to construct, operate and maintain than a gravity system. In a vacuum sewer system, the zone of the lowest pressure is at the vacuum station and the flow will always be towards it, because air propelled by the pressure gradient in the sewers pushes the waste water through to the vacuum tank. A low lift pump station is required at the vacuum station to lift the waste water into the onwards conveyance system. A household can either use the conventional flushing toilets or low flush toilets, which use significantly less water per flush. Waste water flows as a result of gravity to a collection

chamber, which is located near the household. From there, the waste water in the collection chamber is regulated by a pneumatic interface valve, which is normally closed. A pneumatic sensor/actuator opens the interface valve when effluent in the collection sump reaches a pre-determined level. A batch of approximately 30 litres is discharged, which pushes it along to the vacuum station. The vacuum station incorporates a vacuum generator, which is coupled to the underground tank and activated between high and low pressure points. Finally, the waste water at the vacuum station is either discharged to the treatment plant or into a convenient sewer.

According to Otterpohl (2003:31), the vacuum toilet system for urban areas can be adapted even for high-rise buildings with a vacuum collection system and with urban production units. Grey water is available for re-use, infiltration or discharge after appropriate treatment. This system can be used for 500 to 20 000 inhabitants in densely populated settlements and is suitable for areas where a certain technological complexity can be handled. In addition, the same type of technology can be implemented in a low-tech way with simple digesters, especially in countries with a warm climate. This type of technology can be incorporated into new construction projects to offer more cost effective solutions that have a number of advantages (Otterpohl, 2003: 32).

According to Roediger (2005:9), the vacuum sanitation technology is an effective water saving method. The vacuum sanitation technology is an advanced technique with regard to economical and ecological aspects. New buildings as well as the sanitation of old buildings or the construction of existing buildings are all appropriate fields of application. The vacuum sanitation systems are preferably used in buildings where the waste water flow is high or varies (hotels, restaurants, motorway service areas, airports and railway stations), in bigger building complexes and in commercial industrial halls, where the sanitary installations are often located at remote distances. Vacuum toilets need only one litre of water flush. Air is used as a medium of transport instead of precious water. As a special feature, vacuum lines are installed vertically into the suspended ceiling. This flexible pipe layout is important in industrial buildings and/or in

public buildings. “Where formerly the design of conventional toilets and washing facilities depended on the positioning of the gravity lines, sanitary installations can, using vacuum technology, be designed and assembled completely independent from any structural restrictions” (Roediger, 2005:9).

5. THE URINE DIVERSION SYSTEM

The urine diversion system is also known as a dry-box toilet and is widely used in developing countries such as Vietnam, China, Mexico, El Salvador, Ecuador, Guatemala, Ethiopia, Zimbabwe and South Africa (Austin & Van Vuuren, 2001:31). According to the authors, this technology mirrors fundamental characteristics, flexibility features, health and environmental advantages. The main characteristic associated with this technology is the low moisture content, which prevails in the faeces receptacle. The most creative ways of compressing the moisture content is through the sprinkling of ash, dry soil, and sawdust over the faeces after defecation. Urine is diverted at the source by a specially designed pedestal and precludes mixing with the faeces. This process, which facilitates dry conditions in the faeces compartment, presents fundamental advantages for the agricultural sector. The desiccated faecal matter is an essential ingredient for good soil conditioning, while urine is an excellent fertiliser, rich in nitrogen, phosphorus and potassium.

Peasay (2000:5), defines the dry sanitation or urine diversion systems as the onsite disposal of urine and faeces without the use of water as a carrier. This process includes many of the most popular options for low cost sanitation, including pit latrines, ventilated improved pits and san plats. Dry-box sanitation also demonstrates particular interest in the re-use of human waste as a fertilizer and the development of compost. The associated characteristics of dry sanitation are to promote re-use through appropriate technology for community settings without sewerage or plenty of water (Peasay, 2000:12). It has been heralded as solving many of the problems encountered by other sanitation systems. These include fly breeding, smell, groundwater

contamination, short pit life and pit collapse. Complementary, dry-box sanitation technologies are functioning safely and efficiently in communities on a long-term basis.

Peasay (2000:14) explains that the growing literature on dry sanitation is aimed to increase an understanding of the dry-box sanitation technology. Though the relationship between human faeces and diseases was not yet understood, the value of human faeces as a fertilizer was not known in Syria. Urine was evaporated and faeces sun dried, collected and sold. In China, farmers built roadside privies to attract travellers so that they could collect the resulting fertilizers. In the 1930s in India, aerobic biological decomposition of human faeces was practiced and in the 1940s, the Gopuri double-chamber dry toilet system was invented. Since 1954, a double-chamber toilet has been used in Vietnam. Ventilation pipes were added to both the Vietnamese and the Gopuri systems to remove the odours.

Furthermore, “Cilvus Multrum” was developed in the 1930s by the Swedish engineer, Richard Lindstrom. It consists of a concrete sloped-bottom single chamber with two baffles and air ducts. In 1964, it was manufactured from fibre glass and patented and in the 1970s it was licensed for use in the United States. Clivus Multrum is ranked as the best known composting toilets in the world. Such composting toilet systems have clearly been shown to be cost-effective and resource efficient when operated correctly.

According to Peasay (2000:15), there are two main processes employed in dry sanitation with re-use, being decomposition and dehydration.

- Decomposition-toilets are based on a biological decomposition process which uses bacteria, worms or other organisms to break down the faeces, producing compost. Many designs recommend the addition of other organic matter such as vegetable scraps, straw, wood shavings or coconut husks. The temperature and airflow are carefully controlled in such designs to optimise conditions favourable for composing it. It is important that airflow is sufficient to maintain aerobic conditions in the faeces pile and urine is not usually diverted. The end-product is

a fine compost that can be used as a soil conditioner. The additional liquid produced is either evaporated or allowed to flow into soak-pits.

- Dehydration-toilets, based on the process of dehydration, do not generally mix the faeces and urine. The urine is diverted and either collected or allowed to flow into a soak-pit. The faeces are collected in two chambers below the toilet seat and are dried by the addition of lime, ash or earth to the chamber after defecation. The addition of these absorbents is reported to reduce flies and eliminate bad odours. Once the chamber is full, it is sealed and the other chamber is used. When the second chamber is full, the first chamber is opened. The contents of the first chamber is removed and used as a soil conditioner, buried or decomposed.

6. CONCLUSION

The purpose of this chapter was to gain an understanding regarding the conceptual framework of ecological sustainable sanitation. Through analysing the literature it becomes clear to grasp the formidable challenges, which are posed by the inadequate sanitation in developing countries. Amongst the challenges mounted on public health are the rapid population growth, poverty and the lack of financial and technical expertise by local authorities. It has been noted that settlers living in slums or shanty towns are discriminated against due to their poverty status and ultimately they are denied essential urban services. However, it is high time for policy makers to realize that these people are at risk of disease conditions and do contribute to the pollution of the environment. Owing to the absence of adequate sanitation systems, people are forced to introduce unsustainable pit latrine toilet facilities which are polluting the underground water. Least to say, something drastic must be done by the authorities if 4 million children died as a result of diarrhoea caused by inappropriate or the absence of an effective public health system. An effective public health system across the formal and informal settlements will reduce diseases and curb the cost of treating epidemics.

Against this background, the study will encourage coordinated roles of various disciplines to effectively manage sanitation as a global public problem.

CHAPTER THREE

CASE STUDY ON ECOLOGICAL SUSTAINABLE SANITATION

3.1 INTRODUCTION

The thrust of this chapter is intended to transcend the previous chapter, in which the core idea was based on the principle of gaining understanding on public health as the essence of the study. Against this background, this case study will explore the policy, legal and constitutional frameworks governing the planning, management and implementation of the sanitation programmes within Namibia. In pursuing this approach, it is believed to uncover whether policy planning on sanitation is linked to aspects of sustainability. Through this undertaking the researcher is eager to develop an understanding about the rate of implementation of sanitation programmes and successes achieved at national, regional, local and community levels. As planning frameworks of national development, focus will be directed towards Vision 2030 and the National Development Plans to assess the commitment demonstrated towards sanitation for the Namibian citizens.

As the core focus of the chapter, the researcher will take a closer look at the development initiatives undertaken by the Mariental Municipality for the informal settlement. This approach will be twofold, namely: to find out the development efforts made by the Mariental Municipality, particularly the sustainable sanitation for the settlers and to find out whether the latter institution is in support of the sustainability principle as an important dimension of the contemporary development planning. The results of the pilot study which was conducted in the Takarania informal settlement will be discussed. This approach will enlighten the researcher about the scope of the problem posed by a water borne sanitation system on a scarce resource such as water. In addition, the continued reliance and perception that conventional water borne sanitation systems are the panacea of modern development must be readdressed. Flush toilets are understood

to be synonymous with development and social upliftment, without realizing the looming threat caused by the unsustainable consumption of water in an arid country such as Namibia. Against this background, behavioural and policy change is of importance to address this social dilemma.

3.2 CONSTITUTIONAL AND POLICY FRAMEWORKS

The birth of a new nation on 21st March 1990, has led to a democratic constitution in the Republic of Namibia. As a stimulus to improve the quality of life at local level and providing impetus to sustainable service delivery, it was appropriate for the establishment of a national, regional and local government system to facilitate development planning. In terms of Chapter 17, Article 129, sub-article 1 of the Namibian Constitution, "There shall be established in the Office of the President a National Planning Commission, whose task shall be to plan the priorities and direction of national development".

In terms of Chapter 12, Article 102, sub-article 3 of the Namibian Constitution (1990), "Every organ of regional and local government shall have a Council as the principal governing body, freely elected in accordance with this Constitution and the Act of Parliament referred to in Sub-Article (1) hereof, with an executive and administration which shall carry out all lawful resolutions and policies of such Council, subject to this Constitution and any other relevant laws". Propelling a local governance system in the context of decentralization, the Namibian Government has passed a legal framework, namely the Local Authority Act, 1992, Act 22 of 1992 as amended in 2002. This particular act contains legal provisions, responsibilities and tasks, which are aimed to guide local authorities in terms of sewerage provision as clearly stipulated in section 38, sub-paragraph (a). It pronounced the construction and maintenance of a sewerage system within each local authority's area of jurisdiction.

Amidst the constitutional and local authority legal frameworks, the decentralization policy framework was developed, adopted by the Namibian Cabinet in 1996 and embraced as a national policy approach by the National Assembly. It should be perceived as a complementary development strategy to provide a development conduit on social, political, economic and cultural challenges experienced by citizens. The hallmark of the policy is embedded in the principle of enhancing democratic participation of people at lower levels to achieve sustainable democratic development. To uphold participatory planning in development the decentralization policy promotes community participation and consensus. In an attempt to realize the former sentiments in practical terms, the document advocates for the establishment of coordinating and development committees in each local authority. It is the aspirations of the established committees to allow that collective developmental goals and objectives agreed upon result in socio-economic transformation of the impoverished masses. Amongst the four objectives of the decentralization policy, the study is keen to highlight the most crucial objective, namely; in improving the capacity of regional and local government councils to plan, implement, manage and monitor delivery of services for their constituents.

Taking note of the above, it is essential to highlight the core development functions of the local authorities, namely;

- To facilitate the establishment of a community based information management system in the area;
- Identify and assess community needs or problems, which should be considered for local authority development proposals;
- Prepare and evaluate development proposals for the local authority for the final approval by the Councils management committee;
- Initiate, encourage, support and participate in community selfhelp projects and mobilize material, financial and technical assistance;
- Monitor and evaluate the implementation of projects for the area, which was funded by the government; and

- Evaluate and recommend for the approval to the Council, investment proposals for the area (Decentralization Manual, 1998:50).

3.3 THE LEGISLATIVE AND INSTITUTIONAL FRAMEWORK FOR SANITATION

According to the Namibia Global Research Consultants (2001:23), at least eight government ministries deal with waste management and pollution control. It is clarified that waste and sewage managed by local authorities, tends to fall between the mandates of the Ministry of Health and Social Services and the Ministry of Agriculture and Rural Development as far as supervision is concerned. As of late, regional government has not been directly responsible for waste management and pollution control. Most of these functions were directly plan and managed from the national level. It is further explained that with decentralization, the Ministry of Regional Local Government and Housing will become responsible for coordination of activities previously undertaken by the Directorate of Rural Water Supply of the Department of Water Affairs in the Ministry of Agriculture and Rural Development, including sanitation. Proclaimed municipalities have traditionally been the institutions responsible for waste management and for the provision of sanitation in terms of water borne sanitation systems. Few older towns, with the exception of Windhoek, have efficient waste management systems and this responsibility is often undertaken by untrained staff. Many new proclaimed towns also lack trained staff, efficient systems or suitable disposal sites. Water borne sanitation systems managed by the local authorities in Namibia are usually based on evaporation ponds overseen by the Department of Water Affairs and for which exemption permits are granted. The system is not rigorously controlled and lacks the necessary authority to enforce improvements where they are necessary. From personal observation by the researcher, the condition of the water borne sanitation system, which is being managed by the Mariental municipality is not in a severe condition. It is evident to note that the water borne sanitation system of Mariental municipality is subjected to a management plan.

3.3.1 THE WATER AND SANITATION POLICY OF NAMIBIA

In pursuit of an organized planning system, the water and sanitation policy measures were formulated under the auspices of the Ministry of Agriculture, Water and Forestry (National Development Plan 2, 2001:212). Policy documents or guidelines were evolved as management tools with the sole purpose to direct and control water and sanitation programme interventions within the spheres of national, regional and local levels. Secondly, the policy framework serves as a mechanism to increase the broader understanding of the potential linkages between sector project planning and implementation, which is in tandem with the legislative context of Namibia. Thirdly, the formulations of such policy guidelines are inherent to ensure policy outcomes that would lead to a greater level of equity, service provision and sustainability.

According to the National Development Plan 2, (2001:212), the water and sanitation policy was formulated and holds the following objectives, namely:

- Essential water supply and sanitation services should become available to all Namibians;

- The equitable improvement of services should be achieved by combined efforts of the government and the beneficiaries, based on community participation and acceptance of a mutual responsibility;

- Communities should have the right, with due regard for environmental needs and the resources available, to determine which solutions and service levels are acceptable to them; and

- Environmentally sustainable development and utilization of the water resources of the country should be pursued in addressing the various needs.

As a drive towards a positive health and sanitation outlook in Namibia, the government has achieved sanitation coverage in rural areas (National Development Plan 2, 2001:376). In numerical terms, adequate sanitation coverage in rural areas rose from 12 per cent to 30 per cent between 1991–1996 (National Development Plan 2, 2001:378). Access to safe drinking water also rose from 42 per cent to 70 per cent in the same period for rural populations compared to a drop from 99 per cent to 95 per cent in the urban areas. In the light of the positive initiative undertaken, there is a reality that water-related diseases continue to be a major cause of illness and death. This phenomenon is based on the reality that there is slow implementation of an effective sanitation and hygiene programme. Secondly, the surging of safe drinking water in the rural areas was attributed to the decentralization and empowerment of rural water point committees. Rural areas are primarily using pit latrines and the bucket system as a form of sanitation to dispose of human waste. Somehow, this practice is tolerable, because rural areas are not densely populated and do not pose severe environmental and public health threats. If it is been managed inadequately, it will translate into the contamination of the groundwater source as well as community drinking water wells.

3.4 THE SANITATION PLANNING FOR NATIONAL DEVELOPMENT

During the planning stage of the National Development Plan 1, the government provided the characteristics and activities for the sanitation sector (National Development Plan 1, 1995:410). The government is admitting that the sanitation sub-sector is lacking direction to the division of responsibility, institutional capacity and finance. In generic terms, the waterborne sanitation is frequently perceived as a requirement for a minimum acceptable standard of living. Further attention is drawn to the fact that the establishment, operation and maintenance of a sewerage system is expensive and frequently not financially viable. It is evident to note from the National Development Plan 1 that larger towns are financing their sewerage system by a monthly charge to residents. Areas or towns, which lack sufficient finance and technical skills to maintain the system, is prone to deteriorating conditions of health. The government is aware of the high capital cost in installing water borne sewerage systems.

The function and responsibility of sanitation in urban areas is placed under the auspices of the Ministry of Regional and Local Government and Rural Development. However, constraints have been identified by which the local authorities lack the necessary capacity to plan and collect sufficient revenues to finance the operation and maintenance costs of a water borne sanitation system. The establishment of a water borne sanitation system is unlikely to provide lasting benefits and prevent the potential occurrence of health problems. In order to augment desired results, the National Development Plan 1 spells out that local authorities need to be assisted to develop the necessary capacity. It is being argued that alternative models of sanitation should be examined to lessen the burden of conventional water borne sanitation (National Development Plan 1, 1995:411). As a way of resolving the present public health system, the following models are recommended, namely:

- Small bore sewerage system (it carries only liquids and solids and stored on-site)
- Cess-pits (it is commonly referred to as septic tanks) where both solids and liquids are kept on the site; and
- On-site dry or wet pit latrines. (liquids leach into the ground and the solids are allowed to compost and is removed mechanically from time to time).

As far as rural sanitation is concerned, the majority of water borne sanitation in communal areas is located at public buildings such as schools and clinics. It is further mentioned that non water borne sanitation is a dominant feature in the rural areas and is the most neglected sub-sector. Few households have latrine facilities which contribute to the poor health status among the rural population and lower income groups in urban areas.

Sanitation strategies for Vision 2030 are outlined as follows:

- Providing excellent, affordable health care for all;
- Creating access to abundant, hygienic and healthy food, based on a policy of food security

- Maintaining stable, productive and diverse ecosystems managed for long-term sustainability;
- Leveraging knowledge and technology for the benefit of the people;
- Achieving collaboration between public, private and civil society organizations in policy formulation, programming and implementation (National Planning Commission, 2003:41).

3.5 THE CONVENTIONAL EMPIRICAL SANITATION CHALLENGES

Ecological sanitation is an ideal sanitation framework, because Southern Africa is prone to recurrent droughts, water shortages and on-going severe sanitation backlogs (McDiarmid, 2004:2). Prior to putting into context case studies on sanitation challenges, it is critical to reflect on the dynamics caused by water scarcity. The National Development Plan 2 (2001:212) informs readers that water sustainability is associated with hydrological and hydro geological systems. According to Moorson et al. (1995:160), rainfall in the interior of Namibia is extremely limited and variable. Furthermore, most of the water in the country for multiple use is sourced from the border rivers. As a supplementary measure, water is also drawn from boreholes to satisfy the increasing multi-disciplinary needs of the human population.

In December 1968, the City Council of Windhoek commissioned a modern water reclamation plant on the city's northwestern outskirts where waste water is filtered and purified and blended with potable water (The Namibian, 2006:7). The plant produces 21 million litres of water a day, or 35 per cent of Windhoek's daily water consumption. Semi-purified water coming from the city's sewerage plant is used to water the city's parks and sports fields. Another water saving measure undertaken by the City Council is the system of prepaid water points in shantytowns. It is estimated that 650 people from the rural areas flock to Windhoek every month and erect shacks on the outskirts. The municipality provides them with dry toilets and water taps. The informal residents have to buy water credit cards and insert the cards at the tap, when fetching water. Through this approach, water is being used in a responsible manner.

There appears to be a clear contradiction between sustainable consumption logic and continuous utilization of conventional water borne systems. In support of the latter sentiment, Kohima (February 26, 2006) who is employed by the Mariental Municipality revealed a frightening reality. He asserted that 9-12 litres of water per household are flushed each day through the traditional conventional sanitation system. From his observation, high peak of sanitary utilization by households takes place between the morning and late afternoon. To substantiate his observation, he mentioned that the size of households in the urban areas is made up of around five members as against four members in the rural areas. To warrant better understanding, Kohima reflected the latter scenario in a mathematical equation: 5 members/household x (2) times of frequent usage x 12 litre/day = 120 litre of water per day which is wasted by individual households each day for disposing of human waste.

3.6 THE SOCIAL PROFILE OF MARIENTAL AND THE INFORMAL SETTLEMENTS

From the researchers observation the conventional water borne sewage system is widely managed by the Mariental Municipality to control transmission of excreta-related diseases. According to the Central Bureau of Statistics (2001:40-41), it is stated that one third of the households in the Hardap region have no toilet facility. This is certainly a frightening and dreadful revelation, whereby the Mariental urban constituency shows that 35.9 per cent of its users reverting to the bush as a form of toilet facility.

According to Stubenrauch Planning Consultants (1997:33), the Aimablaagte township is harmoniously subdivided into 958 residential plots (excluding business and other institutional plots). The coordinated and orderly subdivided erven have individual household installation for flush toilets. On the contrary, the marginal and decaying informal settlements such as Takarania, Ombili, Oshitotwa and Oshiwana Penduka are all scattered around the town of Mariental. These informal settlements are characterized by none or inadequate sanitation facilities, whilst standpipes are scattered

randomly to satisfy the water needs of the impoverished population. By estimation, there are close to 3 000 inhabitants who are seeking sanctuary in these sub standard informal settlements. In a personal communication held with Kohima (June 26, 2007), it was indicated that the Mariental Municipality has embarked upon a town planning scheme for the informal settlements. In 2002, the planning and formalizing of the Takarania informal settlement was done and the actual relocation started in 2004 whereby settlers were forced to move to new demarcated erven. In total 277 new demarcated erven were planned. Planning of urban services for this settlement included roads, prepaid water, electricity, refuse removal, maintenance of roads and dry sanitation on a pilot basis (urine diversion system).

The methodology, results and recommendations of the pilot project study dry sanitation will be put into perspective. During the pilot project study, participatory methods and evaluation tools have been applied in order to get a clearer picture of the local situation (Mariental Municipality, 2004:7-11).

The main activities of the pilot project methodology (based on participatory observation) include the following, namely:

- Visits and meetings with 12 stakeholders in Mariental
- Focus group meetings with settlers living in the Takarania settlement
- Total of 25 households were interviewed from 245 households.
- Field visits and revision of the general health regulation
- Analysis of water from sources, bore holes, springs and waste water sampling
- Analyzing the sanitation situation for the Takarania settlement
- Identify options about the possibility of using ecological sanitation products as fertilizers and for soil conditioning.

Pilot project study results:

- Large proportion (94 per cent) of the respondents are in support of well maintained public toilets and are willing to pay an average price of N$ 1.43
- In terms of ecological benefits, 64 per cent of the families are aware of the nutrient values of organic matter which is provided by the kitchen
- The reuse of grey water is common among 56 per cent of the families, whilst the remaining portion is not practising the latter activity
- As far as water consumption is concerned, none of the families boil water before drinking
- Most of the settlers are using the prepaid stand pipes and experience frequent shortages in the supply of water
- All (100 per cent) interviewed households are yearning to improve their sanitation conditions and 56 per cent of the respondents need safe toilet installation
- From the respondents, 36 per cent are willing to manage their own toilet sub-products

Recommendations:

- It has been concluded that the conventional gravity system for the settlement would require a lift station and force the municipality to invest large capital for infrastructural development
- In order to avoid blockage, due to water shortage, non prepaid flush water systems are recommended for the Takarania informal settlement
- Amongst the various dry sanitation technologies, the urine diversion system is preferred by the settlers
- Respondents maintained that urine diversion system toilets have the same comfort and functionality features which are similar to the conventional toilets.

Planning for the other three informal settlements, notably upgrading started in 2005. Due to limitations posed by town lands, the municipality was necessitated to conduct the planning on the existing settlements. The land has been surveyed and essential services such as road infrastructure and electricity have been introduced, except sanitation services. According to Kohima (June 26, 2007), the process was cumbersome because people have already settled themselves. On the issue of propagating the ecological sustainable sanitation concept, there was no formal discussions or meetings convened with the settlers living in these three informal settlements. However, it was observed by the latter official that the settlers were not really keen in supporting the ecological sanitation concept. Contrary to his observations, he mentioned that the municipality has fully committed to drive the ecological sanitation system as a public health initiative.

Table 3.1 Mariental Municipality Tariffs:

Services	**Oshiwana Penduka**	**Ombili**	**Takarania**	**Estimated Monthly Income**
Number of standpipes	7	3	6	
Unit price of water	N$ 7,00	N$ 7,00	N$ 7,00	
Price of water tokens	N$ 93,00	N$ 93,00	N$ 93,00	
Prepaid unit price of electricity	N$0,57	N$0,57	N$0,57	
Total water monthly income				N$ 12,010.00
Total electricity monthly income				N$ 118,180.00

Source: Mariental Municipality, 2006

4. CONCLUSION

The main focus of this chapter was meant to reflect critical case study elements that were directly linked to the sanitation discipline as it experienced by the informal settlements around Mariental. It is true to agree with the literature analyses that water shortage in semi-arid countries will pose irreversible human and environmental threats, which will be beyond our capability to manage. Therefore, it is essential for poor and moderate people to change their attitude and strive towards the acceptance of systems that guarantee environmental integrity.

With reference to the legal and constitutional provision as stated earlier, it became apparent for local authorities not to turn away from their mandatory functions. The obvious thinking that settlers who resided on unserviced plots should not be provided with urban services by local authorities must come to an end. It has been noted that municipalities have been non-responsive to the needs of poor households and perceiving them as customers who are costly to serve and unable to pay their bills. The other trend observed was that the local authorities charged with the responsibility for infrastructural provision were reluctant to serve those living on illegal town lands. As reference to the decentralization policy, it is crucial to enhance the effective participation of communities in issues affecting their livelihood. It is acceptable to agree that delivery of services is essential, but without community participation, it will result in community disempowerment and implementation of unsustainable projects.

CHAPTER FOUR

RESEARCH FINDINGS ON ECOLOGICAL SUSTAINABLE SANITATION FOR THE OSHIWANA PENDUKA INFORMAL SETTLEMENT IN MARIENTAL

4.1 INTRODUCTION

This chapter constitutes the important part of the study and is aimed to analyse data about the social and environmental problems caused by inadequate sanitation in the Oshiwana Penduka informal settlement. The data collected will serve as a frontrunner to develop new theoretical knowledge about the sanitation phenomenon in the Oshiwana Penduka informal settlement. The raw data, which was collected from the study population in the form of a semi-structured questionnaire, will be transformed into themes. Data will be filtered, analyzed and interpreted to increase an understanding about the underlying socio-economic problems, which are daily realities of the informal settlers. As stated in Chapter 1, the hypothesis was phrased as follows, namely, “the study will be based on the assumption that social and environmental problems are not directly connected to the absence of a sanitation system”.

4.2 ANALYSIS OF HOUSEHOLD SURVEY RESPONSE

Refer to Annexure A for the interview schedule.

Table 4.1: Age group

Age Groups / Years	N	%
18-24	11	8.50
25-34	44	33.80
35-44	41	31.50
45-54	16	12.30
55-64	13	10.00
65 and over	4	3.10

From Table 4.1 it is clear that the majority of the households interviewed fall into the age category of 25-34, which in total represents 85 per cent of the young people.

Table 4.2: Marital status

Marital Status	N	%
Single	64	49.20
Married	38	29.20
Widowed	2	1.50
Cohabiting / Living Together	25	19.20

Table 4.2 indicates that 49.20 per cent (64) of the respondents are single whereas 29.20 per cent are married.

Table 4.3: Home language

Home Language	N	%
Afrikaans	8	6.20
Damara / Nama	40	30.80
Oshiwambo	72	55.40
Rukavango	9	6.90

The Oshiwambo language is the most dominant spoken language by the settlers, followed by the Damara/Nama language. The fact that the language is widely spoken by 55.40 per cent of the settlers justifies that the name of the informal settlement is derived from the Oshiwambo language. However, this scenario is contradictory because the dominant language widely spoken in the region is Damara/Nama.

Table 4.4: Sex

Gender of Respondents	N	%
Male	75	57.70
Female	53	40.80

Table 4.4 shows that the majority of the respondents living in the informal settlement are men, which in proportional terms represents 57.70 per cent as opposed to 40.80 per

cent for women. Based on the high number reflected by men, it could be further concluded that the problems of sanitation in the informal settlement are exacerbated by the menfolk. Furthermore, men are more keen than women to urinate indiscriminately at any place that suits them best at that particular moment. This unacceptable sanitary practice as perpetuated by men could be partly linked to the biological make up and social acceptable by the general populace.

Table 4.5: Level of education

Level of Education	N	%
Less than primary school (Grade 7)	117	90.00
High school graduate (Grade 12)	12	9.20

Table 4.5 indicates that 90 per cent of the total households interviewed completed their school career not further than the primary educational level. This depicts that this study population lacks technical knowledge regarding the social and environmental problems which are caused by poor and inadequate sanitation. Owing to this low literacy level, it can be concluded that the settlers have a low level of understanding on the planning interventions on sanitation.

Table 4.6: Number of occupants in household

No. of Occupants in Household	N	%
1	6	4.60
2	10	7.70
3	18	13.80
4	11	8.50
5	21	16.20
6	14	10.80
7	17	13.10
8	16	12.30
9	2	1.50
10	5	3.80
11	2	1.50
12	4	3.10
13	2	1.50
14	2	1.50

From the rankings of 1-14 on the total number of occupants in a household, it emerges from the findings that up to five people live in a one or two bedroom house. This is an indication of overcrowding and the easy spread of infectious diseases in the household and in the settlement.

Table 4.7: Number of children in household

No of Children in Household	N	%
1	20	15.4
2	24	18.5
3	29	22.3
4	12	9.2
5	8	6.2
6	5	3.8
8	3	2.3

The findings of the study concluded that almost every household have close to three children living with them. This trend represents 22.3 per cent of the total households of 130. In a broader perspective, if this particular informal settlement is characterized by poor sanitation, it can result in high infant and child mortality rates.

Table 4.8: Size of household

Size of Household	N	%
One Bedroom	38	29.20
Two Bedroom	38	29.20
Three Bedroom	32	24.60
Other	11	8.50

The results of the household survey show that the majority of the respondents (58.40 per cent) live in one and two bedroom houses. This is an indication of the problem of overcrowding and the risk of infecting each other with contagious diseases at the

household and community level. Furthermore, the congestion of people creates favourable conditions for the rapid spread of a variety of infectious diseases, often in the form of disastrous epidemics.

Table 4.9: Proximity of the house to river for urination

Proximity of House to River	N	%
Less than ten metres	20	15.40
11-30metres	32	24.60
31-50 metres	5	3.80
71-100 metres	21	16.20
101+ metres	49	37.70

From the total number of respondents interviewed, 37.70 per cent indicated that they walk more than 100 metres to the riverbed for urination and defecation. The latter trend is further underpinned by the literature review, which mentioned that the shorter the distance to adequate sanitation facilities the lower the incidence of diarrhoea.

Table 4.10: Total household income

Total Household Income	N	%
Less than N$ 500	62	47.70
N$ 501 – N$ 1 000	30	23.10
N$ 1 001 – N$ 2 000	18	13.80
N$ 2001 – N$ 3 000	3	2.30
N$ 3 001 – N$ 4 000	1	0.80
N$ 4 001 – N$ 5 000	1	0.80

The research findings highlighted that the majority of the respondents fall into the income category of 1- 500 Namibian dollars, which represents 47.70 per cent.

Table 4.11: Employment status

Employment Status	N	%
Formerly Employed	57	43.80
Self-Employed	23	17.70
Part-Time Employed	9	6.90
Seasonally Employed	3	2.30
Unemployed	38	29.20

The majority of the respondents (43.80) stated that they were formally employed in the public and private sector. Those, which were not absorbed in the formal labour market applied their trade in self employment schemes (17.70 per cent) and 2.30 per cent were earning an income through seasonal employment opportunities.

4.12: If self-employed, what types of business are you engaged in?

Based on participatory observation by the researcher, most of the self-employed individuals sold traditional food, like meat, homemade beer, bread and wood.

Table 4.13: Household expenditure for water

Money Spend on Water (N$)	N	%
3	1	0.8
10	10	7.7
20	12	9.2
25	1	0.8
30	9	6.9
35	3	2.3
40	6	4.6
45	3	2.3
50	10	7.7
60	5	3.8
70	5	3.8
80	4	3.1
99	5	3.8
100	4	3.1
110	1	0.8
120	4	3.1
130	4	3.1
140	1	0.8
150	3	2.3
160	1	0.8
180	2	1.5
200	9	6.9
220	2	1.5

230	2	1.5
250	4	3.1
260	1	0.8
300	9	6.9
350	1	0.8
360	2	1.5
400	2	1.5
500	2	1.5
700	1	0.8
1300	1	0.8

The results show that the majority of the households (9.2 per cent) spend a meagre amount of N$ 20-00 per month on water. This trend is suggesting that there is an inverse relation between the low level of spending on water and the quantity / amount of water obtained from standpipes for personal hygiene.

Table 4.14: Sanitation facilities at household level

Sanitation Facilities	N	%
Yes	26	20
No	102	78.5

The majority of the respondents (78.5 per cent) stated that they have no access to sanitation facilities in their homes.

Table 4.15: Types of sanitation for disposal

Types of Sanitation for Disposal	N	%
Open Pit Latrine	23	17.7
Bucket System	14	10.8
Bush / River	84	64.6
Other	6	4.6

From the findings obtained, 64.6 per cent of the respondents indicated that they used the river and the bush as a form of sanitation to dispose of their human waste. The second environmentally unsustainable practice is the use of an open pit latrine system, which represents 17.7 per cent as a mechanism of human

waste disposal. In comparable terms, the bucket sanitation system ranks low, only 10.8 per cent indicated a preference for this system.

4.16: If open pit latrines are used, is it safe for children and the elderly?

Some respondents remarked that it was unsafe for the children and elderly people and that it had not been built with the proper equipment. However, it was observed by the researcher that the users of the pit latrine toilets are not aware that human waste can harm the physical environment.

Table 4.17: Awareness of disease conditions

Awareness of Disease	N	%
Yes	119	91.5
No	10	7.7

The majority of the respondents, 91.5 per cent were highly aware that micro-organisms in human excreta were responsible for the transmission of diseases. This awareness about micro-organisms in the human excreta by the respondents could possibly be linked to indigenous knowledge as opposed to the technical knowledge. Other possibilities of the awareness level were through observation made by the settlers during the process of defecation and the danger of diseases it may cause.

Table 4.18: Emptying of bucket latrine system

Emptying of Bucket Latrine System	N	%
Monthly	16	12.3
Bi-Monthly	1	0.8
Never Emptied	1	0.8
No Response	112	86.2

A large number of respondents (86.2 per cent), showed no response to the question on the emptying of the bucket system. Based on the observation of the researcher, most of the settlers were not inclined towards the bucket system and preferred the bush or river for defecation and urination. Many households around the informal settlement were not in possession of the bucket system toilets.

4.19: Why have you decided to opt for the pit latrine, bucket and ventilated improved pit latrines? Please explain.

The lack of proper sanitation facilities is the most compelling reason for some settlers for the construction of a pit latrine and bucket system toilets. These toilet systems are regarded as an ideal choice to eliminate long distances to walk for defecation at the river and bush. It is also regarded as a comfortable and easily accessible toilet system by the elderly, because they are unable to walk long distances. Moreover, it provides a form of safety for the women.

Table 4.20: Sharing of the pit latrine system by informal settlers

Sharing of Pit Latrine System	N	%
Yes	5	3.8
No	21	16.2
No Response	104	80

The users of the pit latrine toilet system, which constituted 16.2 per cent, responded that they are not willing to share with other members of the informal settlement. A very small proportion of the people interviewed, 3.8 per cent are not foreseeing any problem in sharing the toilet facility. The denial of sharing the toilet facilities with other neighbours indicates that people are forced to excrete at any open place which has far reaching implications for human health and environmental pollution.

4.21: What are the reasons for not sharing toilet facilities with other members of the informal settlement?

Some of the respondents are sceptical about the cleanliness and health status of the settlers and refuse to share toilets, because of the disease conditions which prevail in the settlement. They are of the opinion that some are not co-operative and will cause dirt. According to the respondents, this will attract the spread of contagious and infectious diseases.

Table 4.22: Awareness about the contamination of water

Awareness About Water Contamination	N	%
Yes	25	19.2
No	42	32.3
Total	67	51.5
No Response	63	48.5

Though 48.5 per cent of the respondents indicated no response, 32.3 per cent indicated a lack of awareness about the contamination of underground water by the pit latrine system.

Table 4.23: Overflowing and health problems caused by poorly constructed pit latrines

Overflowing and Health Problems	N	%
Yes	30	23.1
No	26	20.0
No Response	74	56.9

From the findings obtained, 23.1 per cent of the respondents mentioned that they are aware of the above mentioned health problems.

4.24: Why was it decided to urgently address the poorly constructed pit latrines?

In most cases, the problem is not well attended and simply ignored. As a measure of solution, the inhabitants are constructing new toilet facilities if existing toilets collapse.

Table 4.25: Knowledge of environmental pollution by defecating in open areas

Knowledge on Environmental Pollution	**N**	**%**
Yes	118	90.8
No	12	9.2

From the findings, it was observed that the overwhelming majority of (90.8 per cent), who find refuge for sanitation in the river are aware of the environmental pollution which is caused by open defecation.

Table 4.26: Waste accumulation causing health conditions

Waste Accumulation	**N**	**%**
Yes	120	92.3
No	10	7.7
Total	**130**	**100**

A large majority, 92.3 percent mentioned that they knew about the serious human health conditions, attributed by waste accumulation in streets.

Table 4.27: Community defecation

Community Defecation by Men and Women	**N**	**%**
Together	12	9.2
Separate	101	77.7
No Response	17	13.1

In spite of the absence of toilet facilities, 77.7 per cent of the respondents showed adherence to the cultural values and practices and stated that women and men defecated separately in the riverbed.

Table 4.28: High demand for defecation in the riverbed

High Demand for Defecation in the River	N	%
18-24	11	8.50
25-34	44	33.80
35-44	41	31.50
45-54	16	12.30
55-64	13	10.00
65 and over	4	3.10

Table 4.28 shows that 33.80 per cent of the respondents revealed that high demand for defecation in the riverbed was done by the age group of 25-34. It is evident to note from Table 4.1 that this informal settlement is inhabited by this age group.

Table 4.29: Assessing the knowledge level on the environmental pollution problems

Knowledge Level on Environmental Pollution	N	%
Yes	90	69.2
No	6	4.6
No Response	34	26.2

From the results obtained, 69.2 per cent of the respondents confirmed their knowledge on matters pertaining to environmental pollution.

Table 4.30: Outbreak of diseases such as diarrhoea and cholera

Outbreak of Disease	N	%
Yes	64	49.2
No	25	19.2
Don't Know	41	31.5

According to 49.2 per cent of the respondents, incidences of diarrhoea, cholera and worm infections were detected in the informal settlement.

Table 4.31: Awareness that overcrowding facilitates infectious diseases

Problems of Overcrowding	No.	%
Yes	104	80.0
No	1	0.8
Don't Know	25	19.2

The findings stated that 80 per cent of the respondents were well aware that the rapid spreads of infectious diseases are caused by overcrowding.

4.32: What method of disposing of bathing and washing water is practised?

The general response was that, after bathing and washing water is thrown away into the streets. Another disposing method is the dumping of waste water in the municipal rubbish bins.

4. 33: What is done with infant faecal matter?

It is either disposed in the public waste bins or thrown into the streets.

Table 4.34: Inadequate sanitation considered a problem by the community

Inadequate Sanitation	N	%
Yes	126	96.9
No	2	1.5
No Response	2	1.5

The majority of the respondents, 96.9 per cent confirmed that inadequate sanitation is regarded as a major problem by the inhabitants of the informal settlement.

Table 4.35: Acquisition of sufficient water for household hygiene and sanitation

Acquisition of Sufficient Water	No.	%
Low	39	30
Moderate	26	20
High	64	49.2

It is visible from the study results that a high number of respondents, 49.2 per cent, need large quantities of water from the communal standpipes.

4.36: What type of safe health measures is being employed in households to prevent the contamination of water?

Water containers are covered to avoid contamination and sometimes water is boiled before consumption.

4.37: What types of materials are used for anal cleaning after defecation?

Toilet paper and newspaper are used by the majority for anal cleansing, whilst others use sticks and stones in the absence of the latter.

4.38: In your opinion, do health problems prevailing in the settlement relate to the non-availability of toilet facilities (sewerage system)?

The yes response from the open ended question indicated that more than eighty respondents interviewed stated that the health problems prevailing in the settlement are caused by the non availability of toilet facilities.

4.39: How does the human excreta and urine stench affect the household?

It attracts flies and insects and it causes severe health problems. If there are strong winds, the bad smell prevails in the air and causes breathing and nausea problems.

Table 4.40: Community organization in the informal settlement

Existence of Community Organization	N	%
Yes	53	40.8
No	77	59.2

From the table above, 59.2 per cent of the respondents indicated that there is no community structure in place, as a tool for development to serve the interest and social challenges faced by the informal settlement. This finding is in contrast to the core objective of the decentralization policy, which emphasizes community participation and decision making in development planning.

Table 4. 41: Discussion of sanitation issues with community organization

Discussing Issues of Sanitation	No.	%
Yes	47	36.2
No	71	54.6
No Response	12	9.2

From the study results, 54.6 per cent of the respondents mentioned that there is no working relationship with community leaders in discussing issues of sanitation.

4.42: How are community decisions made?

Some sections of the community are of the opinion that community decisions are taken on an individual basis by the dominant groups. Others claimed that community decisions were made at gatherings through a participatory process. Some stated that they had no idea about the community meetings and decisions. If the constituency development committee structure was operational and functional, the informal settlement could have a delegated member on the latter structure. This representative could have been tasked to be the authentic mouthpiece of the community at important discussion forums.

Table 4.43: Absence of sanitation facilities affects school going children

Negative Impact of Sanitation on Children	N	%
Moderately	44	33.8
Severely	81	62.3
No Response	5	3.8

Table 4.43 indicates that 62.3 per cent of the school going children are severely affected by the absence of sanitation facilities. If this problem of poor sanitation is not addressed on time, it could result in physical and emotional stress and consequently affect the educational progress of the children. The settlement is already characterized by the low literacy rate (Table 4.5) and failure to address this problem could attract further socio-economic catastrophes.

Table 4.44: Accessibility and affordability of water through standpipes

Accessibility and Affordability of Water	No.	%
Yes	123	94.6
No	4	3.1
No Response	3	2.3

The acquisition of water through communal standpipes, which is coupled with high introduced rate by the municipality is considered an expensive commodity by the overwhelming majority of the respondents, 94.6 per cent.

4. 45: In what way does the absence of sanitation facilities affect you?

There is a considerable delay in completing household duties and health problems are occurring unabatedly.

Table 4.46: Preferred sanitation system

Preferred Sanitation System	No.	%
Conventional water-borne system	125	96.2
Pit-latrine system	2	1.5
Ecological sanitation system	3	2.3

The most preferable sanitation system is the conventional water borne system, 96.2 per cent. The low percentage of 2.3 per cent for the ecological sanitation system demonstrates the low level of understanding of the latter system by the respondents.

4.3 REPORTING ON THE KEY STAKEHOLDERS RESPONSE

4.3.1 The Mariental Municipality

A semi-structured questionnaire was drawn-up and forwarded to the Town Clerk of the Mariental Municipality for completion. The views and responses recorded in the questionnaire were obtained from the latter official as the accountable person of the municipality (See Annexure B).

Table 4.47: The Mariental Municipality

QUESTION	RESPONSE
Question 1: Vision and mission statement on environmental public health.	Vision and mission address environmental and public health issues. As a standard development procedure, the effects of any development on the environment are being considered before development projects are undertaken. This is regarded as a legal requirement by the Mariental Municipality.
Question 2: How does the municipality's legislative base and institutional policies relate to environmental and public health?	The environmental health regulations vigorously address all public and environmental health matters.
Question 3: Are there any synergies between the municipality and other institutions to improve the environmental and public health service provision?	It is alluded that this specific function is solely carried out by the municipality.
Question 4: Understanding of ecological sanitation as a component of the public health system.	The respondent maintains that ecological sanitation is an approach that seeks to protect public health, prevent pollution and the return of valuable nutrients and humus to the soil. Recognition is given that ecological sanitation is an affordable sanitation option.
Question 5: Any concrete programmes or intervention mechanisms to improve the public health services in the target area?	The ecological sanitation concept has been embraced by the municipality and aimed at improving public health in the target area.
Question 6: What is your best response to the lack of adequate sanitation in the case study area?	The respondent indicated that they are doing their best to address the sanitation challenges within their limited financial resources. Alternatively, they also concluded development

	partnership agreements with international and local agencies in solving the sanitation crisis in the informal settlement.
Question 7: How does the municipality's environmental waste management programmes effectively respond to the needs of the areas?	In order to prevent littering or waste, it was found proper by the municipality to strategically place bulk waste containers. However, it is admitted that waste containers are not sufficient to adequately address the problem. The respondent is of the opinion that regular cleaning up campaigns are necessary to ensure cleanliness of the area.
Question 8: Any reported statistics about disease incidences caused by the lack of sanitation facilities amongst the target area's community?	The respondent stated that the municipality is not aware about any reported cases of disease outbreaks, which is directly caused by a lack of sanitation.

Question 9: What type of resources do the municipality possess to optimally address public health development interventions or sanitation delivery programmes in the case study area?	Human and financial resources.
Question 10: How would you rate the municipal service delivery in relation to provision of sanitation facilities and the reduction of water pollution and diseases within the case study?	Bad.
Question 11: State the risks posed by a lack of limited sanitation facilities and any mitigation measures.	It is stated that water borne diseases are imminent risks, but there are no actual cases reported. The respondent mentioned that the improvement of the service delivery function would minimize dire consequences.
Question 12: What are the temporary intervention measures that have been introduced to reduce water pollution?	The responded articulated that there are no concrete intervention measures in the short term to curb water pollution in the target area. However, in the long term they are eager to solve harmful environmental problems.
Question 13: Are there any concrete development initiatives aimed at providing sanitation services in the case study area?	The respondent outlined that the municipality is in the process of providing ecological sanitation toilets and adequate water to all the inhabitants of the informal settlement.
Question 14: How would you rate the status quo regarding the environmental and public health of the case study?	Bad.
Question 15: What are the most prominent amenities provided by the municipality to the settlement?	Water services.

Question 16: What type of intervention does the municipality provide to mitigate environmental and public health hazards in the case study area?	Sufficient water and sanitation facilities.
Question 17: How does the following affect the municipality's service delivery function, namely: urbanization and unemployment?	The respondent mentioned that the latter dimensions are social forces that put severe strain on the scarce resource of the municipality. In order to reverse or mitigate the trend, proactive development policies and plans must be formulated to lure development to the rural areas.

4.3.2 The Department of Water Affairs

A semi-structured questionnaire was drawn up and forwarded to the Regional Head of the Department of Water Affairs for completion. The views and responses recorded in the questionnaire were directly obtained from the latter representative, which is in the employment of the Department of Water Affairs at their regional office.

Table 4.48: The Department of Water Affairs

QUESTION	RESPONSE
Question 1: Mission and Vision statement for water conservation in the context of sanitation.	The mission statement supports the provision of safe drinking water to rural communities. Apart from the mission statement the department envisioned to supply water and sanitation services to 80% of the rural population by 2010. Moreover, the community based management programme intends to improve public health through the provision of safe and adequate water.
Question 2: Do the department's institutional policy contribute to the sustainable environmental and water conservation efforts?	The Department's institutional policies support and promotes sustainable management or scarce water resources. It is geared to build the capacity of the rural communities to sustain their water and sanitation needs.
Question 3: Describe the role and function of the department in the provision of sanitation services in the proclaimed local authority areas.	The provision of sanitation services is strictly limited to the communal areas.

Question 4: What are the health and environmental problems posed by the non/inadequate provision of water borne sanitation in informal settlements?	The respondent indicated an outbreak of water borne diseases such as diarrhoea and bilharzias as common health problems caused by the inadequate sanitation facilities in the informal settlements. In terms of environmental problems, water pollution is a serious human induced problem and has adverse effects on the eco-system.
Question 5: What understanding do you have of ecological sanitation as a public health system?	No concrete information was received from the respondent.
Question 6: What departmental concrete programmes and policy guidelines are in place to improve the environmental and water conservation management through an ecological sanitation system?	As a measure to safeguard environmental and water conservation management, water tanks are supplied to warrant consumption of safe drinking water. The testing of the water quality and quantity are done according to set standards.
Question 7: As a government institution how do you respond to the MDG target for 2015 to ensure accessibility and utilization of sanitation services by the poor?	The respondent stated that the department is committed to the responsibility of ensuring a sustainable supply of potable water to the rural communities.
Question 8: Do you agree that an ecological sanitation system is central to MDG to reduce the health cost as compared to the conventional water borne system?	No concrete information or feedback was received from the respondent.
Question 9: Which sanitation technology or application would be the most appropriate tool in the household?	Ventilated improved pit latrine systems was referred to.
Question 10: What recorded statistics on water borne diseases or reported cases of underground water contamination are caused by the informal settlement of Mariental?	The respondent was not able to provide statistical data.
Question 11: What type of interventions does the department provides to mitigate environmental and water treatment related health hazards in the provision of water supplies?	Sufficient water treatment, adequate ground water analysis and training.
Question 12: Does the department possess the required resources or capacity to affect optimal water and sanitation management in terms of permit issuing, annual inspection and quality standards of sewerage ponds?	No clear response was obtained from the respondent. However, the respondent elaborated that the responsibility of sanitation is under the auspices and mandate of the Ministry of Health and Social Services.

Question 13: How does urbanization, unemployment and pollution affect the departments water service delivery function?	No clear response. The respondent asserted the view that trained community members are leaving the communal areas in pursuit of employment opportunities in urban areas. With regard to water pollution, it was lamented that during and after heavy rains water quality of boreholes are severely affected.

As a key inference, the respondent of the Mariental Municipality is in support of sustainability as an important dimension of contemporary development planning. This way of thinking is embedded in the vision and mission statement of the municipality in addressing their environmental and public health systems. With respect to regional stakeholder engagement, it is sad to conclude that each institution is managing their sanitation programmes in isolation. This scenario is demonstrated by the respondent of the Department of Water Affairs that provision of sanitation services is merely confined to the communal areas. However, the latter respondent acknowledged the fact that the outbreaks of water borne diseases are common health problems caused by inadequate sanitation facilities in the informal settlements.

In a way to assess the level of knowledge of the respondents on ecological sanitation as a public health system, the response provided is characterizing elements of disparities. The respondent of the Department of Water Affairs has failed to provide a meaningful feedback and rather suggesting ventilated improved pit latrine as the most appropriate household sanitation technology. On the contrary, the respondent of the municipality states that this particular system seeks to protect public health, prevention of pollution and the return of valuable nutrients to the soil. As a positive intervention, the Department of Water Affairs is rendering community based training programmes on a regular basis to increase better sanitation practices. This important component is not fully embraced by the municipality, whilst advancing the argument that the provision of bulk waste containers must be perceived as a mechanism of improving sanitation. In the final analysis, both institutions have not done much in developing a sanitation database system as an effort to record disease outbreaks, which is caused by inadequate sanitation.

5. CONCLUSION

The significance of this chapter was to collate and reflect various data sources obtained from key stakeholders, the population of Oshiwana Penduka informal settlement, the Mariental Municipality and the Ministry of Agriculture, Water and Rural Development. This approach is of critical importance when examining and comparing information, which was gathered from different role players. In pursuit of such an approach, it is hoped that the initial hypothesis formulated will be tested or disapproved in the final conclusion of the study. In order to develop a new mode of thinking, a wide range of questions were drawn up, which were stakeholder specific, to enhance an understanding of the existing sanitation problem from diverse interest groups. In the consecutive chapter, an analysis and inference will be drawn to determine positive and negative impacts caused by the absence of adequate sanitation systems. As a point in case, the study population is complaining about the burden of flies and insects, which is perpetuated by the absence of adequate sanitation systems. In other cases, it is alluded that strong winds attribute to the circulation of bad smells in the air and in turn cause breathing and nausea problems.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The central focus of the study was aimed to conceptualize and understand ecological sustainable sanitation as an alternative development philosophy for contemporary urban slums, specifically the Oshiwana Penduka informal settlement. The Mariental Municipality maintains the view that the integration of the ecologically sustainable sanitation model in urban infrastructural planning by the local authorities will considerably facilitate sanitation provision in decaying, marginal informal settlements.

In chapter one, the hypothesis states that the study ***will be based on the assumption that social and environmental problems are not directly connected to the absence of a sewage system***. In chapter 2 a literature review was done to gain knowledge on ecological sustainable sanitation as a core concept, together with key definitions, concepts, components and elements. It is evident to derive from the literature that a sanitation system as a measure of public health was invented to control indiscriminate spread of human faeces and urine. On the contrary an inadequate sanitation system is posing threats to the physical environment. The literature also suggests that in urban areas, sanitation dilemmas contribute to high mortality and morbidity rates. Most prevailing diseases in urban areas of developing countries are transmitted by human faeces. Overcrowding is also a socio-economic burden, which exacerbates sanitation problems in the informal settlements. Such cramped living conditions are fertile grounds for the rapid spread of infectious diseases. In addition to the above, elements of vacuum sanitation and urine diversion systems as integral parts of ecological sustainable sanitation enjoyed attention.

Chapter 3 was meant to explore the policy, legal and constitutional frameworks governing the planning, management and implementation of the sanitation programmes within Namibia. In pursuing this, it is believed to uncovered whether policy planning on sanitation is linked to aspects of sustainability. Through this undertaking the researcher would like to develop an understanding about the rate of implementation of the sanitation programmes and successes achieved at national, regional, local and community levels. As planning frameworks of the national development, focus will be directed towards Vision 2030 and the National Development Plans to assess the commitment demonstrated towards sanitation for the Namibian citizens. As integral part of the study, the researcher has taken a closer look at the development initiatives made by the Mariental Municipality for the informal settlements. This approach was twofold, namely: to find out the development efforts made by the Mariental Municipality, particularly sustainable sanitation for the settlers and to find out whether the latter institution is in support of sustainability as an important dimension of contemporary development planning. The result of the pilot study which was conducted in the Takarania informal settlement was fully discussed. In the final stage of the chapter, conventional empirical sanitation challenges as potential threats were outlined.

In chapter 4, the survey results were revealed as instruments to enhance an understanding about the social and environmental dynamics which are related to an inadequate sanitation system.

Other features which emanate from the survey results show that the majority of occupants live in one or two bedroom houses. It could be concluded from the findings that the housing conditions in the informal settlement is characterized by overcrowding. This suggests that infectious diseases can easily be contracted and transmitted across the entire settlement. The latter notion was put into perspective by the literature review, whereby a large number of people created conditions very favourably to the rapid spread of a variety of infectious diseases. There is a strong view that the pattern of overcrowding and the burden of infectious diseases can be eliminated in the urban slums through the provision of quality houses. Furthermore, it was agreed upon by 80

per cent of the respondents that they were aware that the rapid spread of infectious diseases is facilitated by overcrowding. The findings suggest that 16.2 per cent of the households indicated that makeshift houses consist of two rooms and occupied by five people. This scenario depicts conditions of overcrowding, which is a serious social problem in the informal settlement. Interesting to note, was that 49.2 per cent of the respondents as opposed to 19.2 per cent revealed the outbreak of cholera and worm infections in the informal settlement. In the final analysis, a response rate of 78.5 per cent indicated no sanitation facilities at individual houses. This situation is a direct result of social and environmental problems in the informal settlements.

The shift to innovative ecological approaches would help to reduce negative environmental impacts such as the contamination of ground water, waste pollution and the depletion of scarce water resources. Primarily, the water borne sanitation system was built as an enduring solution to curb indiscriminate spread of human disposal, but has inflicted irretrievable damage to the global ecosystem and natural water resources. This conventional sanitation model has negative implications for a country such as Namibia, with its ongoing experience of drought, water shortages and severe sanitation backlogs. The regional budget allocation on sanitation services is seemingly less responsive to realize the fulfilment of Vision 2030. To paint a worse case scenario: if the economy keeps on growing on a current rate until 2030, the objectives set will not be translated into tangible outcomes. More importantly, it would be proper and appropriate to construct a linkage between the annual budget allocation and the sanitation targets in order to warrant a measurable achievement for Vision 2030. In view of the above, the rising population growth will put added strain on limited financial resources and the provision of public health infrastructure. If no concrete actions are taken, the noble goals of Vision 2030 will remain a distant dream.

The analysed data, more specific on the outbreak of diarrhoea and cholera in the informal settlement as social problems are indicated by 49.2 per cent of the respondents than a tiny percentage of 19.2. This illustrates the fact that the aforementioned social problems are as a result of the absence of appropriate sanitation

system in the informal settlement. Notwithstanding the social dilemmas, it is evident to conclude from the overwhelming respondent of 90.8 per cent that environmental problems are rife in this settlement. As part of their coping mechanisms, the settlers covered their water containers to avoid the contamination of water. The second option employed by the settlers was the boiling of water before consumption.

In the final analysis of the survey results, it is concluded that 96.2 per cent of the respondents are in favour of conventional water borne sanitation system. A further conclusion is also drawn that there is the pervasive thinking that a conventional water borne system has been built as an enduring infrastructural solution to control the spread of human waste. Contrary, this latter system has created severe damage to the global ecosystems and the natural water resources.

5.2 RECOMMENDATION

Recommendation 1:

The municipality must embark upon a process of strengthening the legislative powers and institutional policies to address the community and environmental health dilemmas of the informal settlement. As a matter of priority, the Mariental Municipality must take a pro-active approach as far as the maintenance of the public health and environmental protection to the targeted settlement is concerned. It is equally important to integrate the model of ecological sustainable sanitation as part of their public health management programme to ease the sanitation burden of the marginalized informal settlement. The community and environmental health programmes spearheaded by the municipality must contain educational awareness components to sensitize the settlers about the advantages of ecological sanitation. It is widely believed that this awareness approach would substantially change the traditional perception on the water borne sanitation system as the comfortable and enduring solution. With regard to insufficient waste containers in the targeted settlement, it would be more cost-effective to involve community members in regular cleaning-up campaigns to ensure the cleanliness of the

area. As the core function of the local authorities in driving the decentralization policy, proactive steps must be taken by the municipality in setting up functional community development structures. These structures must be constantly strengthened through tailor - made training programmes and financial incentives, so that members serving on the structures fully understand their roles and responsibilities. Initiatives of this nature would substantially increase the capacity of the community and allow them to effectively participate in development planning. More importantly, the participation strategies of community based training and financial support would avoid information asymmetry, misunderstanding and stakeholder dis-engagement.

Recommendation 2:

In order to warrant greater success in the field of ecological sanitation, the policy makers and development practitioners must converge at national and international forums to roll out the ecological sanitation model. The water and sanitation sector must be re-structured to adhere to proposed sustainability principles as planning guidelines towards sustainable sanitation provision. Moreover, those institutions that are directly responsible for the planning and implementation of sanitation projects must undergo a paradigm shift towards the emerged sanitation system. Therefore, it is recommended that institutions such as the Department of Water Affairs and the Mariental Municipality must be assisted financially and technically by the central government in order to develop the necessary capacity in policy formulation and implementation of the ecological sanitation technologies. This approach would gradually and entirely eliminate the conventional models such as small bore sewerage systems and cess – pits. The benefits of this capacity building approach to the latter institutions would realize the objectives of Vision 2030 by providing excellent, affordable health care for all. This recommendation may only be realized, if the planning system is re-adjusted in the context of transdisciplinarity. This fundamental effort will create awareness amongst other disciplines to respect and live in harmony with the ecosystem.

Recommendation 3:

To respond optimally to sanitation challenges, it is recommended that additional funds must be sourced from international funding agencies by the Mariental Municipality that have keen interests and mandates in the water and sanitation sector. Secondly, synergy must be created between the Mariental Municipality and the private sector in order to forge partnership agreements in the development of urban services. Private capital can be sourced under the build-owners transfer arrangement for the construction of sustainable community health infrastructure. The private sector can manage the community health infrastructure and with the municipality purchasing the supply. At the end of the contract, assets are transferred back to the municipality at a pre-determined fee. Such an innovative financing development strategy would ensure massive connections of the sanitation network in the formal and informal settlements. On the contrary, the municipality and the private sector capitalists / leaders should not merely develop sanitation systems through the standard “one size fits all” approach. It is essential for the effective participation of the community in the design, management, implementation and regulation of the sanitation services. It is recommended that the community should be the central actors of their own development and not merely be passive recipients. The delivery of services is essential, but without community participation it will result in disempowerment and unsustainable project implementation.

Recommendation 4:

The Mariental Municipality must boost economic investment levels of the town to raise revenue levels as well as promoting local economic development initiatives for the poor settlers of the informal settlement. This will put the municipality in a competitive position to improve and expand the sanitation services for the poor. It is also imperative for the municipality to reduce their budget deficit in order to commit more financial resources for infrastructural development in the informal settlements. More importantly, the municipality must lobby for funding from the Equity Trust Fund, which is under the auspices of the custodian ministry. This particular fund operates on a grant principle

and is specifically designed to spur massive infrastructural investments in urban services such as sanitation.

Recommendation 5:

As a matter of urgency, the Mariental Municipality must commission a social impact study which consists of interdisciplinary research teams on the informal settlement. The result of this approach will be to gain a comprehensive understanding about the social environmental challenges posed by the absence of a community health system. For example, urban planners can bring to the field perspectives about town designs and how this can affect the behaviour and even the well-being of the people. The urban sociologist can study the interactions that are taking place in the densely populated areas. Finally, the role of the epidemiologist would be to record the burden of diseases in the urban areas and the factors associated with those diseases (e.g. overcrowding and littering). Findings of such a study would equip the municipality better about the sanitation conditions which are prevailing in the informal settlements. More importantly, such an undertaking would better inform the municipality about the percentage of community members who lack proper sanitation services.

Recommendation 6:

Despite the findings of the survey which indicates conventional water borne sanitation as the preferred choice, the vacuum system as an ecological sanitation technology is recommended for this informal community. This particular sanitation system works on the principle of enhancing water conservation, recycling, reduction of health and promotion of environmental integrity.

6. CONCLUSION

In the midst of current poor health and pollution, severe environmental degradation and rapid urbanization, it has become necessary to re-align the sanitation policies and practices. The new proposed sanitation model of an ecological sanitation system must be practised within the realms of water conservation, recycling of nutrients, and the reduction of health and mitigation of environmental problems. The notion and false believe that the conventional water borne sewerage system provides the comfort and convenience must be rejected. With the continuous growth of the urban populations and high incidence of low-income people living in the informal settlements, there is no possibility of providing the conventional water borne sewerage to all.

The natural system has reached a turning point, whereby people should realize that the environment can no longer absorb and clean our excessive human waste. It is also equally true and impossible to provide each household with a state-of-the-art conventional community health system. This particular system turns out to be a very costly item and is mounting a severe stress on the financial capacity of the already cash strapped local authorities. In a way to enhance or promote the ecological sustainability, the demeaning practice of the water borne sanitation systems, which is depleting and polluting the ecosystem must be phased out.

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Appendix A

SURVEY:

HOUSEHOLD SURVEY ON ECOLOGICAL SUSTAINABLE SANITATION

Questionnaire – Informal Settlement

Administrative Box	
Questionnaire No.:	
Settlement Name/Plot No.:	
Name of Interviewee:	

A. DEMOGRAPHIC INFORMATION

1. Age group of respondents

	a) Under 30,
	b) 31 – 39
	c) 40 - 49
	d) 50 – 59
	e) 60 -69
	f) 70+

2. Marital status

	a) Single
	b) Married / Living Together
	c) Widowed / Divorced
	d) Cohabiting/Living Together

3. Home language

	a) Oshiwambo
	b) Damara / Nama
	c) Rukavango
	d) Otjiherero
	e) Losi
	f) English
	g) Afrikaans
	h) German
	i) Tswana
	j) Khoi-san
	k) Other (specify) _____

4. Gender of respondents

	a) Male
	b) Female

5. Level of education

	a) No Schooling
	b) Grade 1-7
	c) Grade 8-12
	d) Diploma / Degree Qualification
	e) Post – Graduate Qualification
	f) Vocational / Technical Training Qualification
	g) Other (Specify)

B. HOUSEHOLD INFORMATION

6. Number of occupants in household

		Age Group	Number of People in Household
	a)	Less than 6 years	
	b)	7-16 years	
	c)	17-24 years	
	d)	25-34 years	
	e)	35-40 years	
	f)	41-49 years	
	g)	50 – 65 years	
	h)	65 +	

7. Number of children in household

No of children in household	N	%
1	20	15.4
2	24	18.5
3	29	22.3
4	12	9.2
5	8	6.2
6	5	3.8
8	3	2.3
Total	130	100

8. Size of household

	a) One Bedroom
	b) Two Bedroom
	c) Three Bedroom
	d) Other

9. Proximity of the house to river

	a) Less than ten metres
	b) 11-30 metres
	c) 31-50 metres
	d) 71-100 metres
	e) 101+ metres

10. Total household income

	a) Less than N$ 500
	b) N$ 501 – N$ 1 000
	c) N$ 1 001 – N$ 2 000
	d) N$ 2001 – N$ 3 000
	e) N$ 3 001 – N$ 4 000
	f) N$ 4 001 – N$ 5 000

11. Employment status

	a) Formerly Employed
	b) Self-Employed
	c) Part-Time Employed
	d) Seasonally Employed
	e) Unemployed

12. If Self-Employed, what types of business are you engaged in?

13. Household Expenditure for Water

Money Spend on Water (N$)	N	%
3	1	0.8
10	10	7.7
20	12	9.2
25	1	0.8
30	9	6.9
35	3	2.3
40	6	4.6
45	3	2.3
50	10	7.7
60	5	3.8
70	5	3.8
80	4	3.1
99	5	3.8
100	4	3.1
110	1	0.8
120	4	3.1
130	4	3.1
140	1	0.8
150	3	2.3
160	1	0.8
180	2	1.5
200	9	6.9
220	2	1.5
230	2	1.5
250	4	3.1
260	1	0.8
300	9	6.9
350	1	0.8
360	2	1.5
400	2	1.5
500	2	1.5
700	1	0.8
1300	1	0.8
Total	130	100

14. Sanitation facilities at household level

☐	a)	Yes
☐	b)	No

15. Types of sanitation for disposal

☐	a)	Open Pit Latrine
☐	b)	Bucket System
☐	c)	Bush / River
☐	d)	Other

16. If open pit latrines are used, is it safe for children and the elderly?

17. Awareness of disease conditions caused by lack of sanitation

☐	a)	Yes
☐	b)	No

18. Emptying of bucket latrine system

☐	a)	Monthly
☐	b)	Bi-Monthly
☐	c)	Never Emptied
☐	d)	No Response

19. Why have you decided to opt for the pit latrine, bucket and ventilated improved pit latrines? Please explain.

20. Sharing of the pit latrine system by informal settlers

☐	a)	Yes
☐	b)	No
☐	c)	No Response

21. What are the reasons not to sharing with other members of the informal settlement?

22. Awareness about the contamination of underground water: pit latrine toilet system

☐	a)	Yes
☐	b)	No
☐	c)	No Response

23.Overflowing and health problems caused by poorly constructed pit latrines

☐	a)	Yes
☐	b)	No
☐	c)	No Response

24.If yes, what was decided to urgently address the pit latrine problem?

25.Knowledge of environmental pollution by defecating in open areas

☐	a)	Yes
☐	b)	No

26.Does waste accumulation pose a threat to health conditions?

☐	a)	Yes
☐	b)	No

27.Community defecation altogether done by men and women

☐	a)	Together
☐	b)	Separate
☐	c)	No Response

28.High demand for defecation in the river

☐	a)	18-24
☐	b)	25-34
☐	c)	35-44
☐	d)	45-54
☐	e)	55-64
☐	f)	65 and over

29.Assessing the knowledge level on the environmental pollution problems

☐	a)	Yes
☐	b)	No
☐	c)	No Response

30.Any outbreak of diseases such as diarrhoea and cholera

☐	a)	Yes
☐	b)	No
☐	c)	Don’t Know

31.Awareness that overcrowding facilitates infectious diseases

☐	a)	Yes
☐	b)	No
☐	c)	Don't Know

32.What method of disposing of bathing and washing water is practised?

33.What is done with infant faecal matter?

34.Inadequate sanitation considered a problem by the community

☐	a)	Yes
☐	b)	No
☐	c)	No Response

35. Acquisition of sufficient water for household hygiene and sanitation

☐	a)	Low
☐	b)	Moderate
☐	c)	High
☐	d)	No Response

36. What type of safe healthy measures is being employed in households to prevent the contamination of water?

37.What types of materials are used for anal cleaning after defecation?

38.In your opinion, do health problems prevailing in the settlement relate to the non availability of toilet facilities (sewerage system)

39.How does the human excreta and urine stench affect the household?

40. Is there a community organization established in the informal settlement?

☐	a)	Yes
☐	b)	No

41. Discussion of sanitation issues with the community organization

	a)	Yes
	b)	No
	c)	No Response

42. How are community decisions made?

43. How does the absence of sanitation facilities affect school going children?

	a)	Moderately
	b)	Severely
	c)	No Response

44. Accessibility and affordability of water through standpipes

	a)	Yes
	b)	No
	c)	No Response

45. In what way does the absence of sanitation facilities affect you?

46. Preferred sanitation system

	a)	Conventional Water-Borne System
	b)	Pit-Latrine System
	c)	Ecological Sanitation System

Appendix B

SURVEY:

ECOLOGICAL SUSTAINABLE SANITATION

Questionnaire – Stakeholders (Mariental Municipality)

Administrative Box
Questionnaire No.:
Name of Institution/Organization:
Name of Interviewee:
Portfolio of Interviewee:

1. Vision and mission statement on environmental public health.

2. How does the municipality's legislative base and institutional policies relate to environmental and public health?

3. Are there any synergies between the municipality and other institutions to improve the environmental and public health service provision?

4. Understanding of the ecological sanitation as a component of the public health system.

5. Any concrete programmes or intervention mechanisms to improve the public health services in the case study area?

6. What is your best response to the lack of adequate sanitation in the case study area?

7. How does the municipality's environmental waste management programmes effectively respond to the needs of the case study area?

8. Any reported statistics about disease incidences caused by the lack of sanitation facilities amongst the target area's community?

9. What type of resources do the municipality possess to optimally address the public health development interventions or the sanitation delivery programmes in the case study area?

10. How would you rate the municipal service delivery in relation to the provision of sanitation facilities and the reduction of water pollution and diseases within the case study?

11. State the risks posed by a lack of limited sanitation facilities and any mitigation measures.

12. What temporary intervention measures are there to reduce water pollution?

13. Are there any concrete development initiatives aimed at providing sanitation services in the case study area?

14. How would you rate the status quo regarding the environmental and public health of the case study?

15 What are the most prominent amenities provided by the municipality to the settlement?

16. What type of intervention does the municipality provide to mitigate environmental and public health hazards in the case study area?

17. How does the following affect the municipality's service delivery function, namely: urbanization and unemployment?

Appendix C

SURVEY:

ECOLOGICAL SUSTAINABLE SANITATION

Questionnaire – Stakeholders (Department of Water Affairs)

Administrative Box
Questionnaire No.:
Name of Institution/Organization:
Name of Interviewee:
Portfolio of Interviewee:

1. Mission and Vision statement for water conservation in the context of sanitation.

2. Does the department's institutional policy contribute to the sustainable environmental and water conservation?

3. Describe the role and function of the department in the provision of sanitation services in the proclaimed local authority areas.

4. What are the health and environmental problems posed by the non/inadequate provision of water borne sanitation in informal settlements?

5. What understanding do you have of ecological sanitation as a public health system?

6. What department's concrete programmes and policy guidelines to improve the environmental and water conservation management through the ecological sanitation system?

7. As a government institution how do you respond to the MDG target for 2015 to ensure accessibility and utilization of sanitation services for the poor.

8. Do you agree that an ecological sanitation system is central to MDG to reduce the health cost as compared to the conventional water borne system?

9. Which sanitation technology or application would be the most appropriate tool in the household?

10. What recorded statistics on water borne diseases or reported cases of underground water contamination are caused by the informal settlement of Mariental?

11. What types of interventions does the department provide to mitigate environmental and water treatment related health hazards in the provision of water supplies?

12. Does the department posses the required resources or capacity to affect optimal water and sanitation management in terms of permit issuing, annual inspection and quality standards of sewerage ponds?

13. How do urbanization, unemployment and pollution affect the department's water service delivery function?

Appendix D

Pictures of urine diversion toilet system

The urine diversion toilet from a front view.

The concept of urine diversion is in favour of re-use as can be seen above. As seen in the picture, the ash collected from fire wood is used to throw over the faeces. Ash is biodegradable and is a good layer before the next usage.